MECHANICAL ENGINEERING

September 1956

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ASME Annual Meeting • New York, N. Y. • November 25-30, 1956

SIMPLIFYING HEAT EXCHANGER AND CONDENSER FABRICATION

The ease with which heat exchanger and condenser tubes can be rolled into tube sheets depends, to a certain extent, upon the uniformity of tube wall. One of the controlling factors of wall uniformity in the manufacture of seamless steel tubing is the contour of the piercer point.

Phil Morrison, a piercer point man, is shown at work on one of B&W's seamless tube mills. One of his duties is to examine the piercer point between each tube making operation. By making certain that the point has not been deformed in service—and that takes experience and a practiced eye—he helps to control wall uniformity in the pierced tube. He knows that although hot and cold work after the piercing operation can minimize, it cannot eliminate non-uniformity of wall section.

Phil's attention to detail, teamed with specially designed piercing equipment, helps to achieve the quality—"ease of rolling-in"—for B&W Heat Exchanger and Condenser Tubes. The Babcock & Wilcox Company, Tubular Products Division, Beaver Falls, Pa.

Seamless and welded tubular products, seamless welding fittings and flanges—in carbon, alloy and stainless steels

FACTS

about

NEW DEPARTURE
BALL BEARINGS

Self-sealed bearings simplify design . . . cut maintenance costs

New Departure originated self-sealed ball bearings to eliminate the most common causes of bearing wear and failure—such as abrasive dirt and improper lubrication. Since then, more than 300,000,000 New Departure sealed bearings have been produced in various types to fit the specific requirements of industry. Seals are available to keep out foreign matter, ranging from dust and dirt to corrosive gases . . . to retain lubricants, varying from heavy grease to light oil . . . to provide the protection that assures longest life.

New Departure's latest advance, Sentri-Seal, embodies exclusive features which importantly improve both bearing performance and range of application. Because of its design, Sentri-Seal provides controlled, highly efficient sealing with low torque and is not materially influenced by axial movement due to bearing end play within prescribed tolerances.

Sealed ball bearings offer the electric motor and machine tool builder many advantages. They simplify design, make it possible to mount motors in any position, cut maintenance to a minimum, and eliminate the need for relubrication for long periods of operation.

WRITE FOR COMPLETE INFORMATION ON NEW DEPARTURE SEALED BEARINGS!

NEW DEPARTURE • DIVISION OF GENERAL MOTORS CORPORATION • BRISTOL, CONN.

MECHANICAL ENGINEERING, September, 1956, Vol. 78, No. 9. Published monthly by The American Society of Mechanical Engineers, at 20th and Northampton Sts., Easton, Pa. Editorial and Advertising departments, 29 West 39th St., New York 18, N. Y. Price to members $3.50 annually, single copy 50¢; to nonmembers $7.00 annually, single copy 75¢. Add $1.50 postage to all countries outside the United States, Canada, and the Pan-American Union. Entered as second-class matter December 21, 1920, at the Post Office at Easton, Pa., under the Act of March 3, 1879. Member of the Audit Bureau of Circulations.

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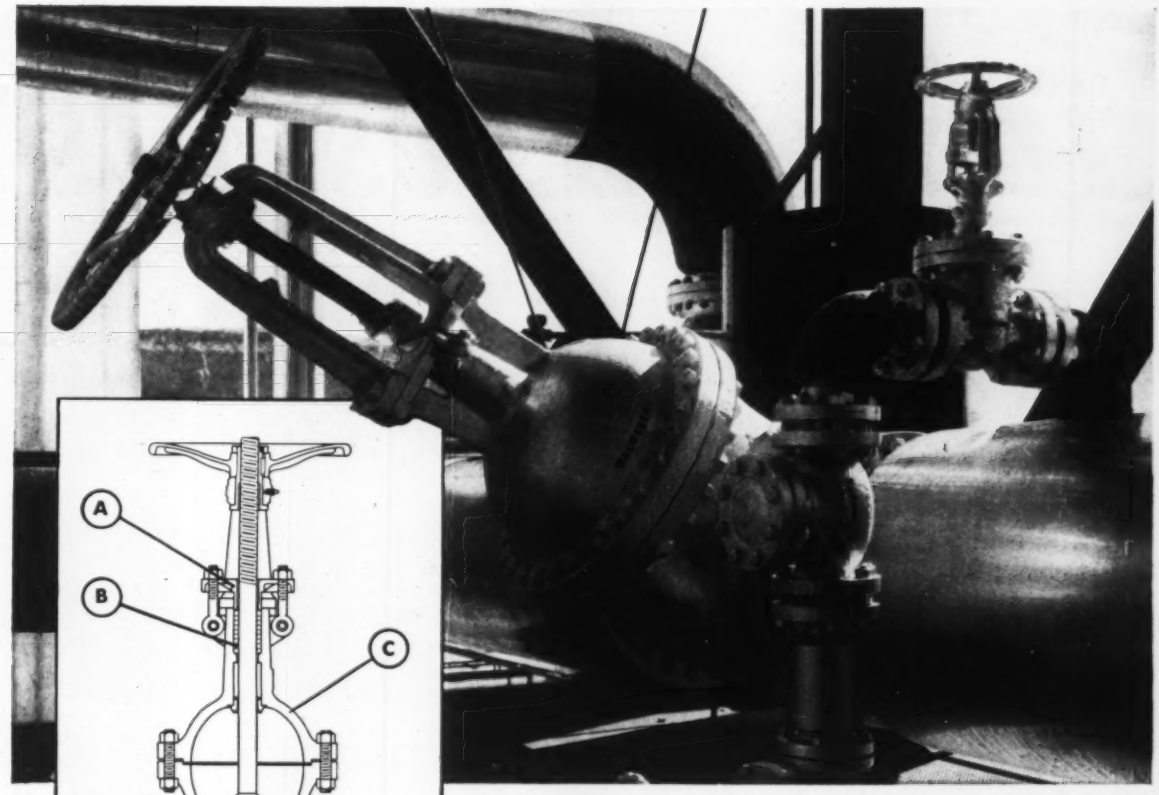

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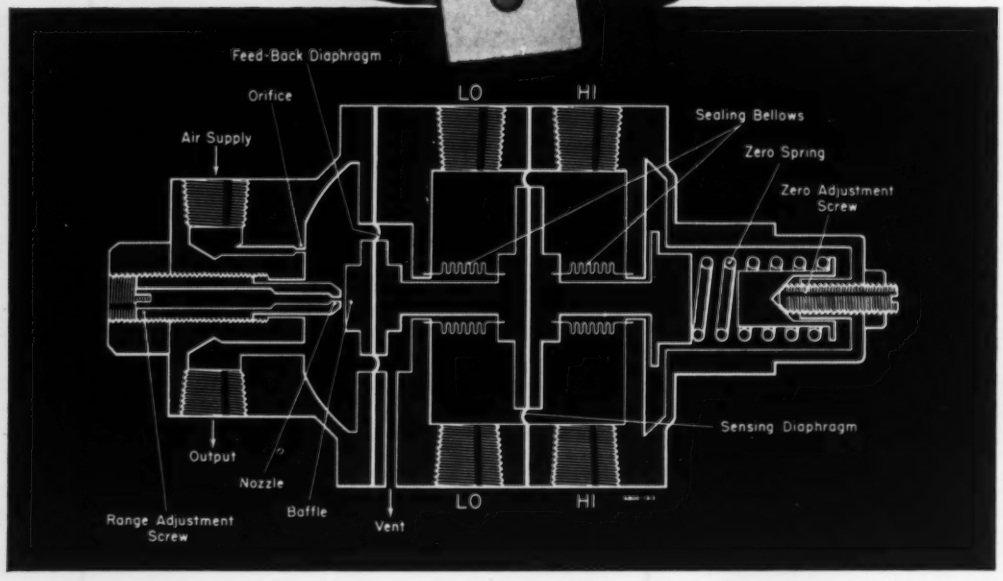
ACTUAL SIZE 6½" x 3"

No. 200TD111



NEW LOW COST FLOW TRANSMITTER

The new Taylor Fixed Range Differential Pressure Transmitter (200TD111) provides an excellent, economical means of measuring flow, liquid level, or pressure. A 3 to 15 psi signal is transmitted to an indicating, recording or controlling receiver with an accuracy of 1%. Its remarkably low price makes it a practical cost accounting aid for many applications previously considered marginal Check these features:

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Reliable accuracy. Calibration accuracy is better than 1%. Unaffected by piping or mounting stresses. No errors build up during operation because of self draining and venting feature. Pressure effect 2%/150 psi (100" range). Temperature effect 2%/100°F. (100" range). Sensitivity exceeds 0.1%.

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Body material brass.
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Air Supply pressure, 20 psi.
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Output pressure range 3 to 15 psi.
Size 6½" x 3", Weight 4 lbs. 9 oz.
All connections ¼" internal NPT.

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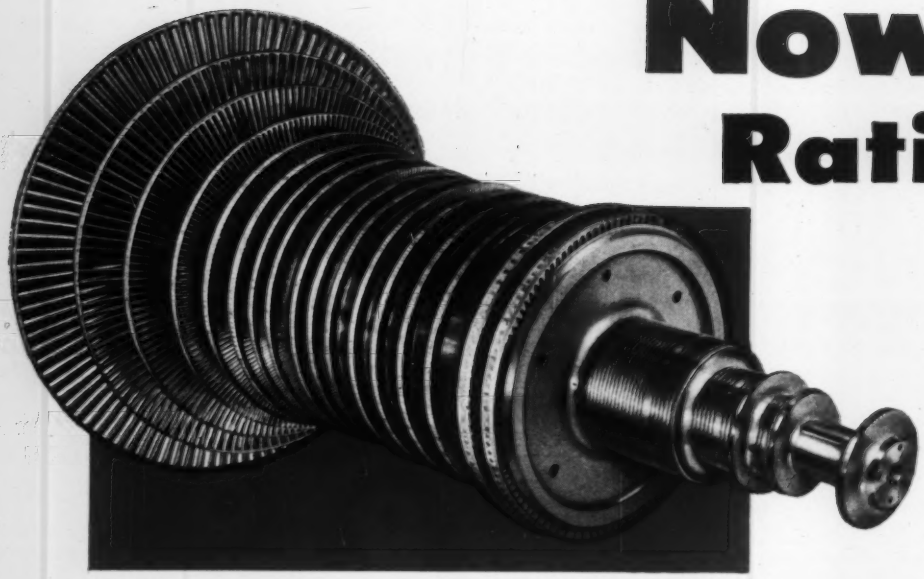
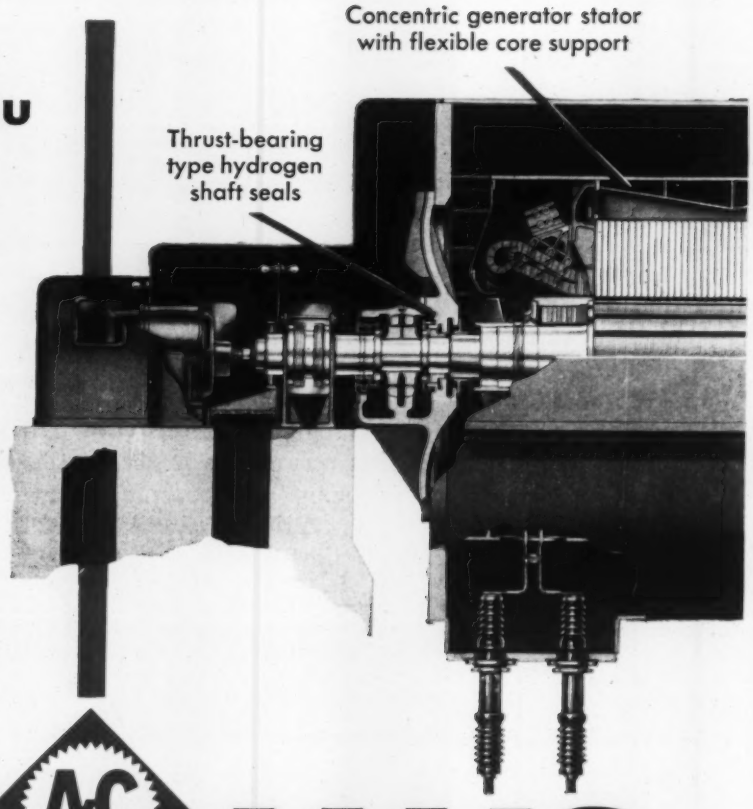


Here is the turbine rotor for one of the 16,500-kw units now being built. For this 850-psig, 900-F AIEE-ASME turbine, rotor shaft and wheels are of integrally forged construction.

Allis-Chalmers Turbines Give You MORE Modern Design Features



CUTAWAY VIEW of 16,500-kw unit shows the development of impulse turbine design for larger ratings.

A-C ALLIS-CHALMERS

ALLIS-

Production up to 16,500 Kw

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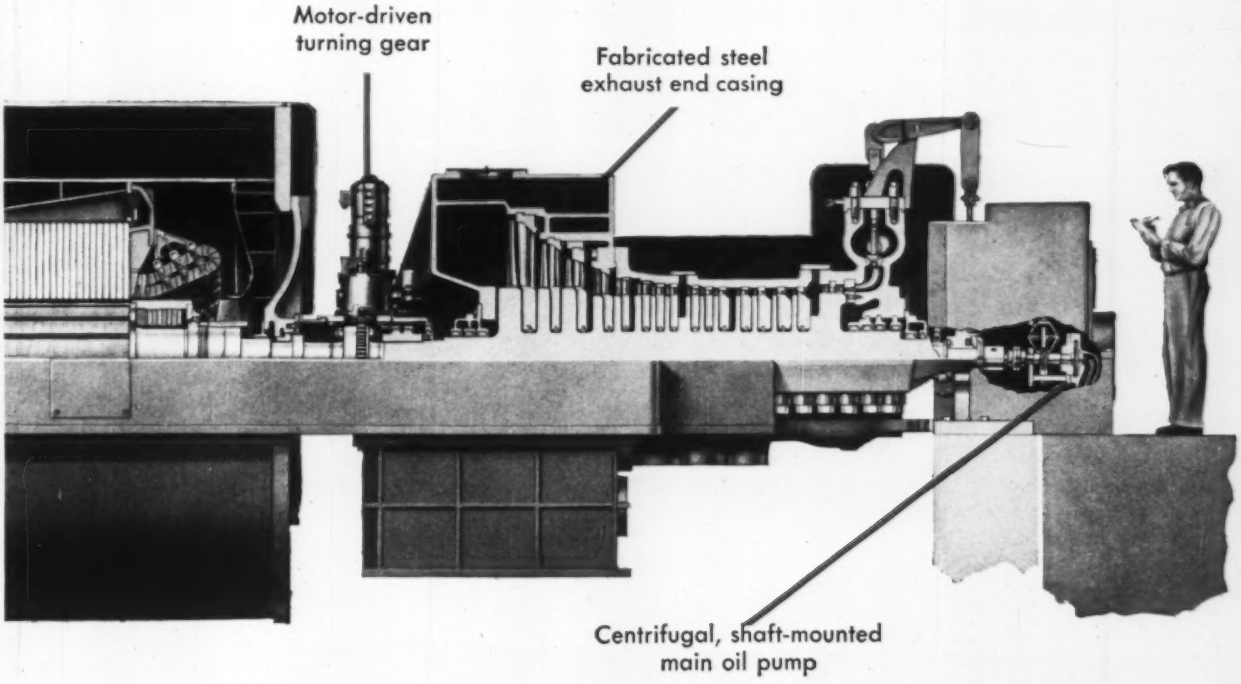
Advanced ● Design Features **Simplified ● Installation** **AIEE-ASME ● and NEMA Ratings**

NEW WA-Series steam turbine-generator units now being manufactured include the 10,000-kw NEMA standard rating as well as 12,650-kw and 16,500-kw AIEE-ASME preferred standard condensing ratings. The 16,500-kw units have hydrogen-cooled generators.

Incorporated in the design are time-proved labyrinth steam sealing, removable external glands, high chrome alloy steel buckets and nozzles, reliable governing system, and unit shipment and installation — plus additional large turbine and generator features.

To get MORE information on economical, dependable units 2000 kw and larger, call the nearest A-C district office, or write Allis-Chalmers, Power Equipment Division, Milwaukee 1, Wis.



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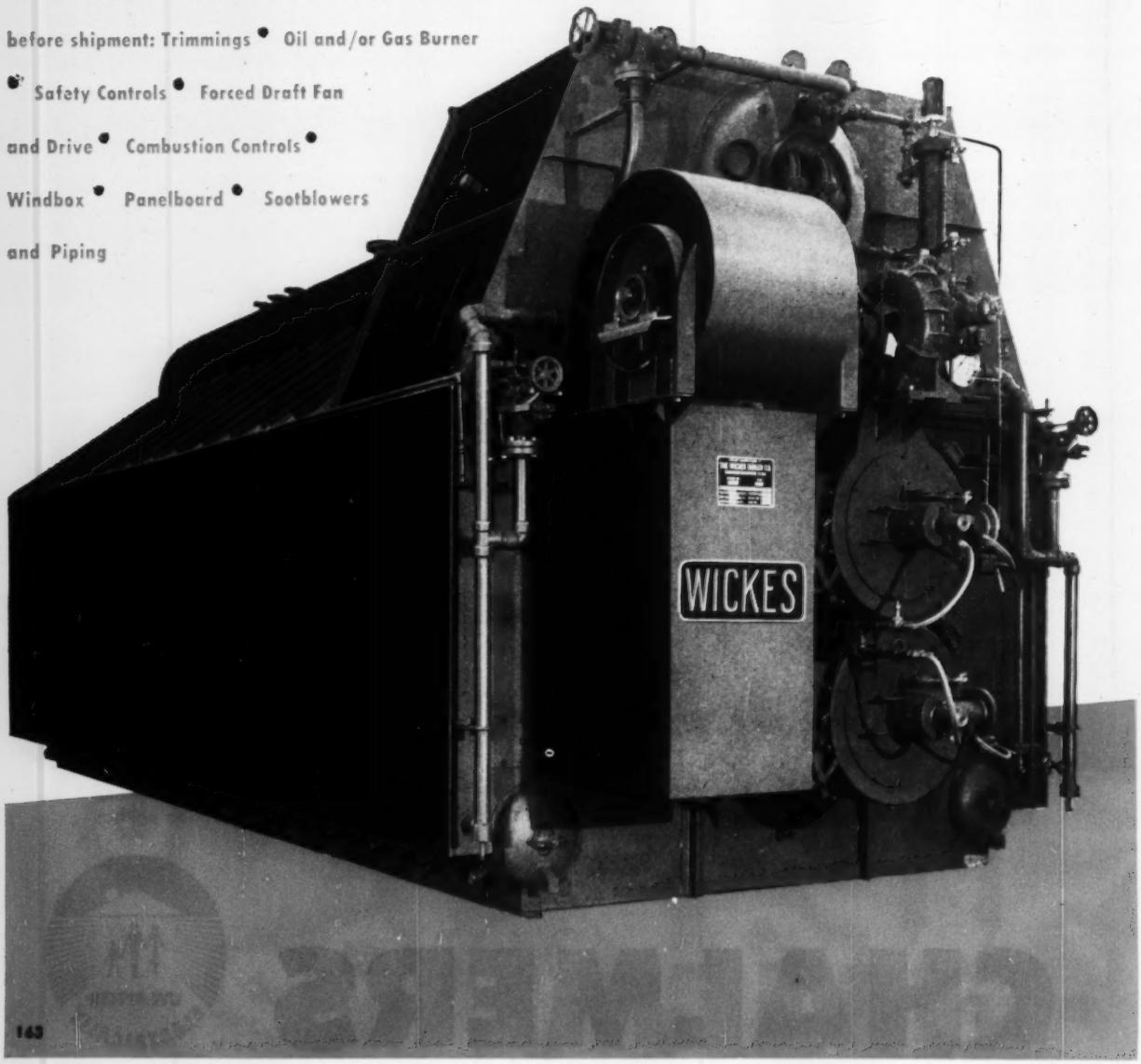

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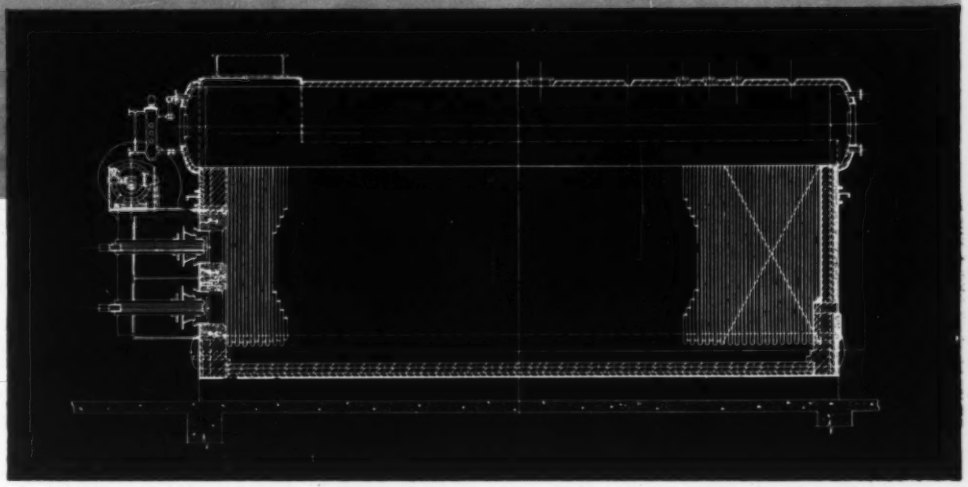
HOUR WITH A SHOP-ASSEMBLED STEAM GENERATOR



With capacities for sustained steam production up to 60,000 lbs. per hour the Wickes Type-A Boilers give you "packaged power" ready for immediate installation. They are custom engineered to your requirements and shop-assembled to reduce interruption of operations in your plant to a minimum. Wickes Type-A packaged boilers conserve head-room and floor space and are very simple in design . . . the large furnace is located between two banks of boiler tubes so that each furnace wall is a separate steam generator as well as an integral part of the boiler unit. The steam generator is enclosed in a high quality refractory and insulation setting and protected by a pressure-tight steel casing . . . thus, the pressurized furnace can be operated without a high stack or induced draft fan when burning oil or gas. This casing is also completely weatherproof for outdoor installation.

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Cylindrical Rollers for High Capacity...

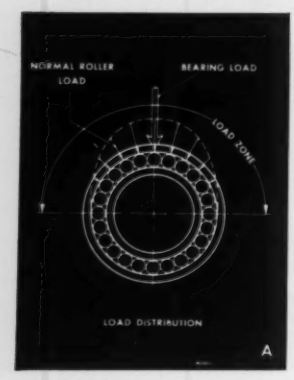
How the rollers distribute the load... effect of local deflection within rollers under load... how roller quality control increases bearing life

The principle of overcoming sliding friction with rollers was known even to the ancient Egyptian pyramid builders, but it is a far cry from their crude logs to precision-ground rollers. Today engineers have a wide choice of bearing designs, and selection is usually gaged by the fundamental yardsticks of accommodation, load-carrying capacity and cost. In many applications, properly designed plain bearings provide operating advantages. Ball bearings are ideal for other applications. But where heavy loads must be sustained in a relatively small bearing annulus, the only practical, commercially-available support is a set of hardened rollers operating in planetary fashion around a hardened inner race and housed in a hardened outer race . . . in other words, a *cylindrical roller bearing.*

Obviously, the design and quality of the *rollers* play a large part in the performance of the bearing. Here, briefly, are some of the vital factors which must be taken into consideration:

1. DISTRIBUTION OF LOAD WITHIN THE BEARING

Every roller in a rotating bearing is subjected to periods of load while in the "load zone," and periods of no load while outside the "load zone." Within this zone, the roller moves from a position of light load to a position on the line of action of the bearing load. Here the normal roller load is a maximum, and the roller in this position is the heaviest-loaded roller in the bearing. Moving beyond this point, the load diminishes to zero at the extremity of the "load zone," as shown in Diagram A at the left.

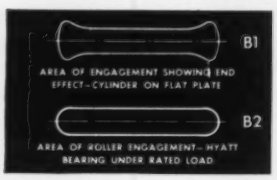


The theoretically perfect "load zone" extends from $-90°$ to $+90°$ measured from the line of action of the bearing load, for a total of 180°. But this is neither practical nor necessarily desirable, since it would require a bearing of zero internal clearance. If a bearing has internal clearance, then it has no "load zone" when under no load; only after load is applied does the heaviest-loaded roller deflect and permit its associates to share the load.

Under normal loadings, the actual "load zone" may range from 90° to 120°, depending on the load and mounted internal clearance. This distributes the load in the bearing so that the load on the heaviest-loaded roller can be approximated by 5/N times the bearing load, where N is the number of rollers.

2. DISTRIBUTION OF LOAD WITHIN ROLLER'S AREA OF CONTACT

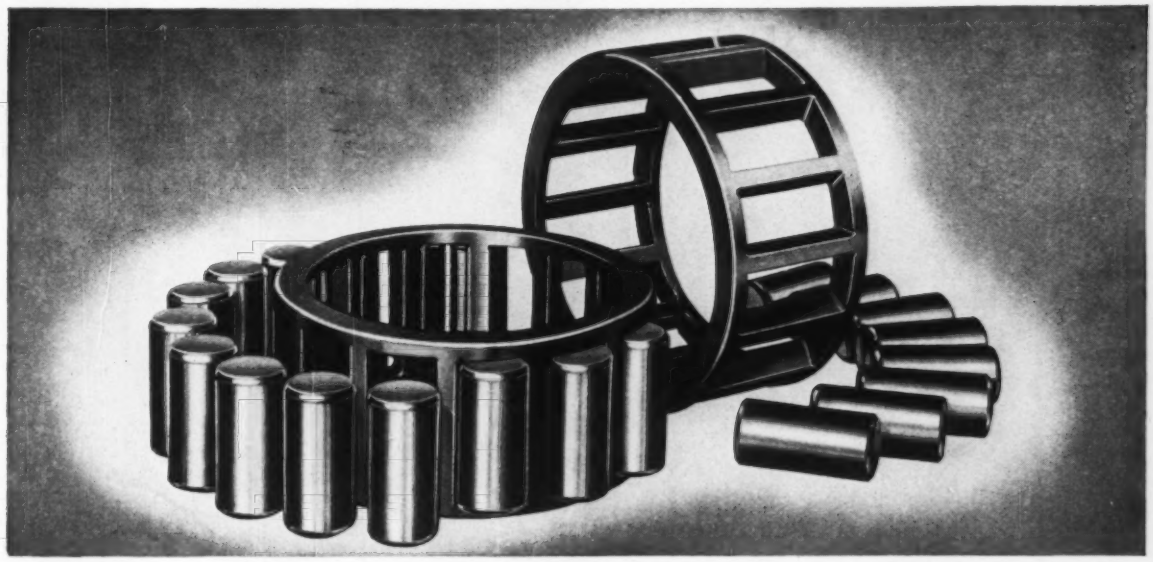
As load is applied to a cylinder between flat plates, the cylinder deflects locally in the region of engagement. The plate also deflects locally, so the original line of engagement under no load is broadened to become a "dog-boned" area (Diagram B1) under load. This broadening of the line of contact is analogous to the spread of the "load zone" from the heaviest-loaded roller to adjoining rollers, as previously described.


B1
AREA OF ENGAGEMENT SHOWING END EFFECT - CYLINDER ON FLAT PLATE
B2
AREA OF ROLLER ENGAGEMENT - HYATT BEARING UNDER RATED LOAD

One other effect is prominent here: deflected cylinders of finite length must gather in metal at their ends in *two planes*, instead of one, as is the case in the center of the roller. *This end-loading effect can seriously reduce the life of a cylindrical roller bearing.* All HYATT Roller Bearings have rollers of either generous corner radii or blended chamfers to reduce end effect. All HYATT Hy-Load Bearings, in addition to generous corner radii on the rollers, have a roller crowning extending a sufficient distance in from the ends to allow the area of contact to "fade out" evenly at the roller ends under normal loads, as illustrated in Diagram B2 above.

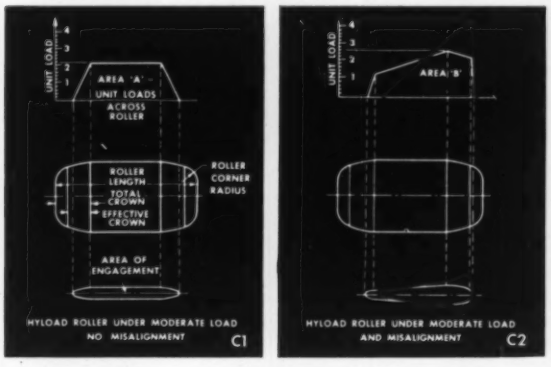
3. DISTRIBUTION OF LOAD ACROSS THE ROLLER

The unit load on any roller is distributed axially in a uniform manner except at the ends where crowning has been provided. Diagram C1 shows how the unit load drops off to zero at the



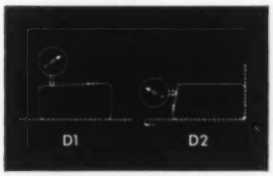
ends of the area of contact. The summation of unit loads represented by area "A" is the total roller load.

This same load applied under conditions of misalignment must result in an area "B" equal to area "A"; but it is apparent that the maximum unit load is considerably greater under such conditions and that the bearing will have a shorter life than one operating with little or no misalignment. Now observe the high unit load represented by area "C," resulting from the same total load applied to an *uncrowned* roller. This aptly demonstrates the value of crowning under conditions of misalignment. Moreover, the value of proper alignment is equally apparent (Diagram C2).

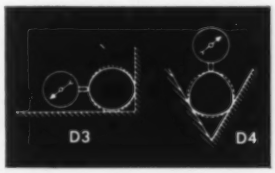


4. EFFECT OF ROLLER QUALITY ON BEARING PERFORMANCE

Quality of manufacture, particularly that of the rollers, has a great deal to do with the performance of a cylindrical roller bearing. For example:



1. A roller with excessive *taper* tends to uneven load distribution and abnormal temperature rise (D1).
2. A roller with excessive *end square* tends to noisy bearing performance (D2).
3. A roller with excessive *two-point out-of-round* tends to poor segregation and poor bearing life (D3).
4. A roller with excessive *three-point out-of-round* tends to noisy bearing operation (D4).
5. A roller with *poor finish* tends to wear on all operating surfaces and noisy operation.



6. A bearing with excessive *roller-to-roller diameter variation* tends to poor bearing life.
7. A bearing with excessive *roller-to-roller length variation* tends to poor thrust capacity and abnormal temperature rise.

All of these factors are scrupulously controlled by the most modern precision equipment to insure maximum performance and life for every HYATT Roller Bearing. HYATT has pioneered many advancements in the control of roller quality and is constantly seeking new ways to carry the complex loads of modern industry even more efficiently.

YOU WILL FIND MORE DETAILS in HYATT General Catalog No. 150, or your nearby HYATT Sales Engineer will gladly help you choose the type of cylindrical roller bearings best suited to your design requirements. Remember, HYATT is America's *first* and *foremost* maker of cylindrical roller bearings. Hyatt Bearings Division of General Motors, Harrison, N. J.

GM GENERAL MOTORS

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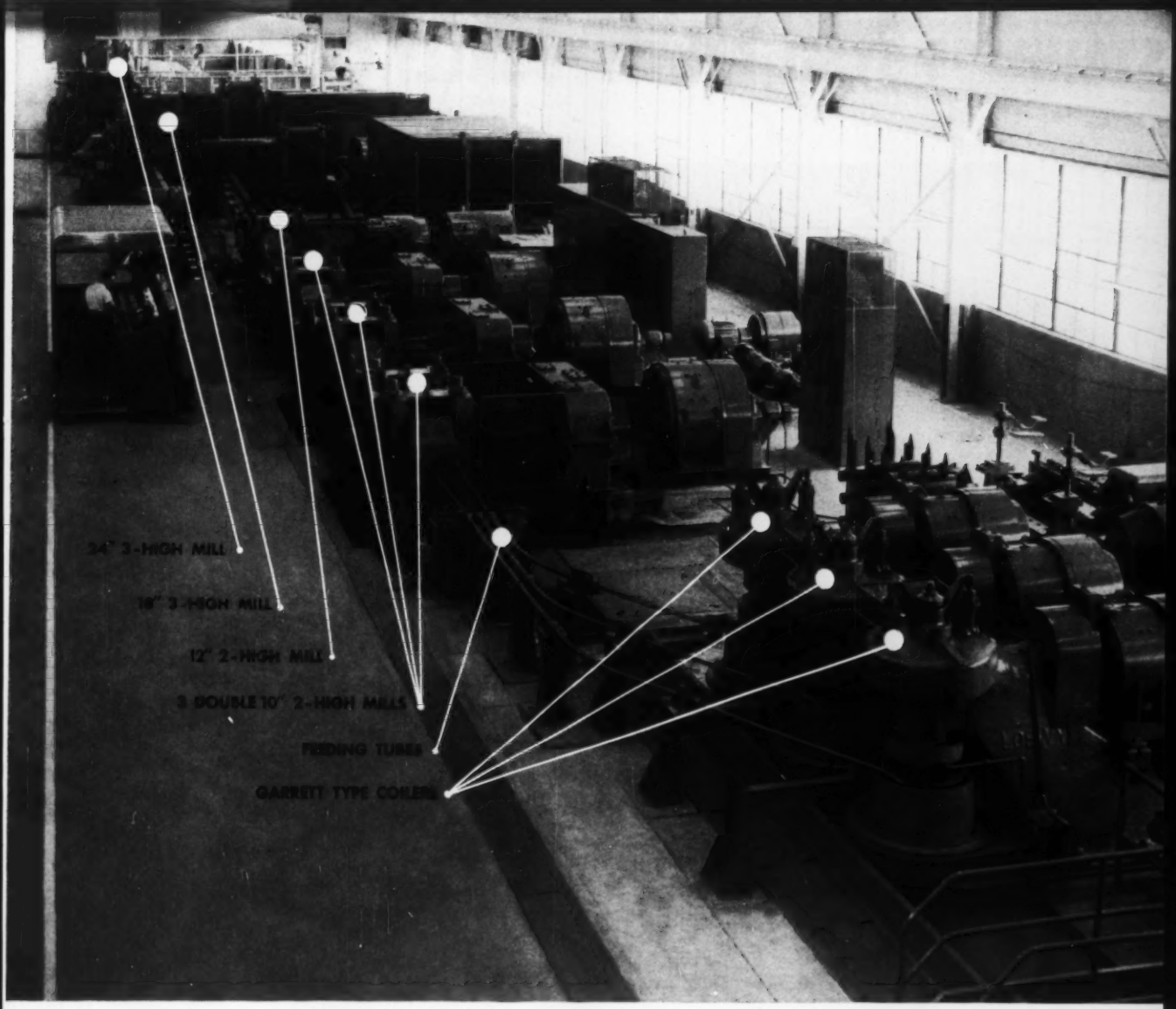


This installation has a capacity of 40,000 lbs per hour for 2-strand rolling with finished coil delivery every 19 seconds.

new Loewy copper wire rod mill reduces wire bars to 5/16" wire rod, automatically

At the plant of a leading manufacturer of electric cable, this new Loewy mill is rolling 5/16" and 7/16" copper wire rod from standard wire bars in a continuous, fully automatic operation.

The mill consists of two 3-high roughing mill stands, seven continuous finishing stands and three Garrett coilers. Copper wire bars are conveyor-fed into the furnace. After leaving the furnace the ingots are rolled down in 14 passes to finished size. Leaving the last stand at a speed of 2400 FPM the wire is coiled. The coils are tied and conveyed into a pickling line. The entire procedure is automatic and all operations are controlled from one operator pulpit.

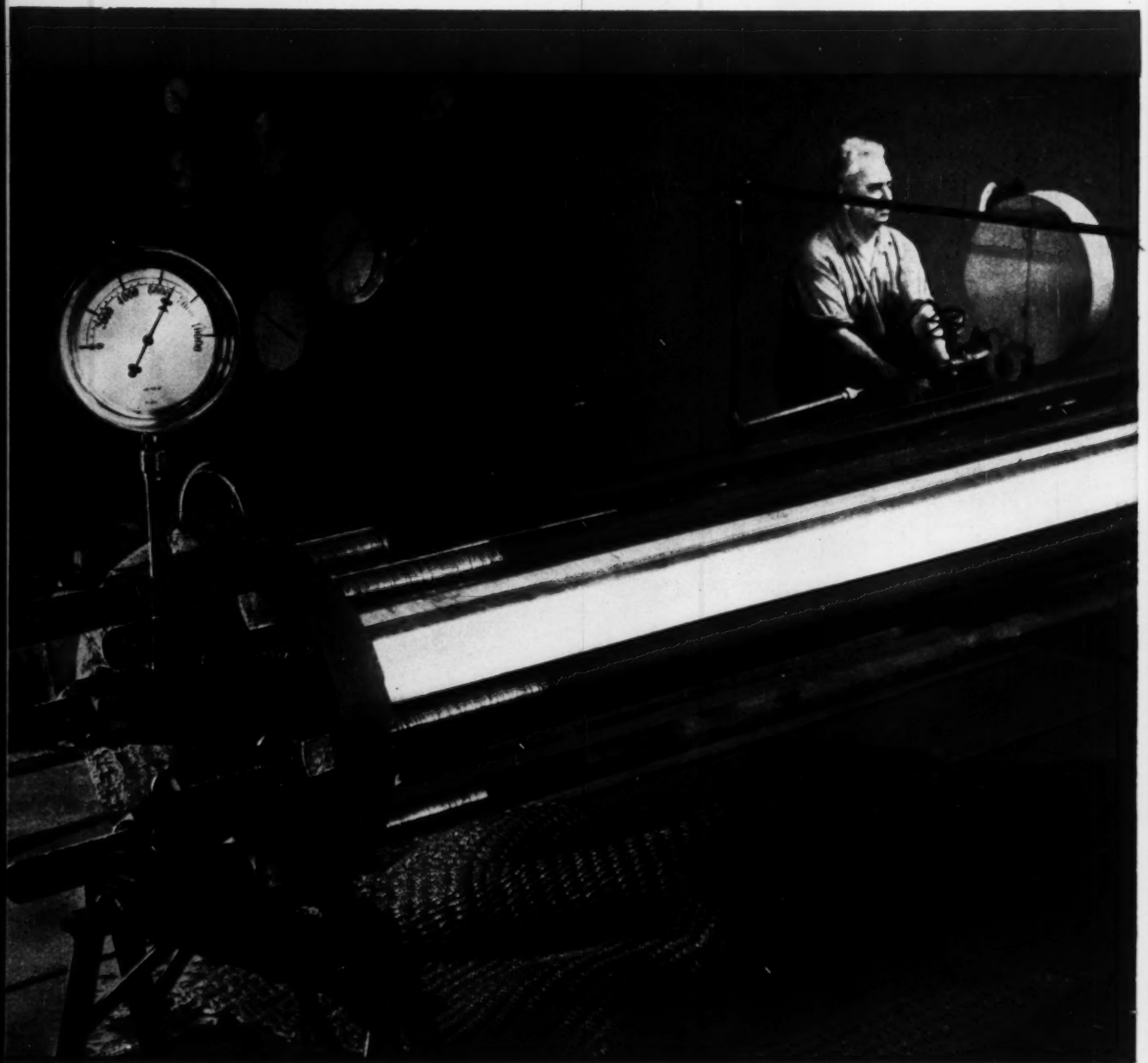
Like this high-speed wire rod mill, all Loewy equipment is designed to produce more, in less time, at lowest cost. We design, build and install blooming and slabbing mills, plate mills, structural and rail mills, bar and skelp mills, continuous billet and strip mills for ferrous and non-ferrous metals as well as high-speed foil mills. For illustrated bulletin 14002, write Dept. 761, Loewy-Hydropress Division, BLH Corporation, 111 Fifth Avenue, New York 3, N.Y.

BALDWIN BLH LIMA-HAMILTON

LOEWY-HYDROPRESS
BALDWIN-LIMA-HAMILTON

DIVISIONS: Austin-Western • Eddystone • Hamilton • Electronics & Instrumentation • Lima • Madsen • Loewy-Hydropress • Pelton • Standard Steel Works

STAINLESS STEEL CENTRIFUGALLY CAST MAY BE



ABOVE: Hydrostatic test rig used to qualify each length of pipe.

UNITED STATES PIPE & FOUNDRY CO.

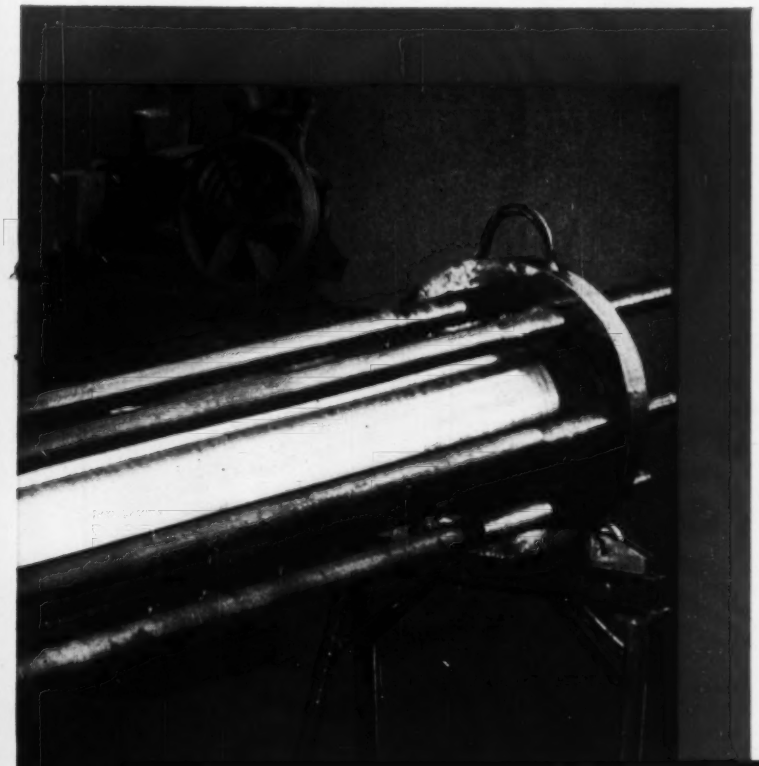
Steel and Tubes Division

STEEL AND TUBES DIVISION U S P

BURLINGTON, NEW JERSEY

SALES OFFICES: LOS ANGELES, SAN FRANCISCO, CHICAGO, ST. LOUIS, COLUMBUS, DETROIT, PITTSBURGH, HARTFORD, BURLINGTON

THE ANSWER TO YOUR PIPING PROBLEM



Patented U.S.P. process meets rigid refinery specifications

The men who design today's petrochemical plants, refineries or Atomic power plants are confronted with piping problems involving temperatures, pressures and corrosive conditions which only a few years ago would have been called impractical, if not impossible.

U. S. Pipe's Steel & Tubes Division recently completed a piping requirement for 700 feet of Type 316 Extra Low Carbon, columbium-bearing stainless for a large petrochemical plant, which is typical of the job metal mold centrifugally cast pipe is doing today under a patented manufacturing process with rigid Quality Control.

U. S. Pipe is headquarters for metal mold centrifugally cast alloy and stainless steel pressure pipe over a wide range of special and standard analyses —in large or small quantities.

Write and outline your refining problems. We may be able to help.

Note these exacting specifications on 316 Cb ELC Stainless Steel Pipe demanded by one of nation's leading oil companies:

MATERIAL REQUIREMENTS: Pipe shall conform to ASTM Specification A-362-52T.

CHEMICAL ANALYSIS: Modified AISI Type 316 Cb (ELC), with *one percent* spread on chrome and nickel.

FINISH: Each pipe to be turned, bored and faced to surface finish of 125 micro inch or better. O.D. tolerance plus 1/16″ minus 0″; I.D. tolerance plus 0″ minus 1/32″.

MECHANICAL TESTS: Tensile Tests—2 tests required on each pipe after heat treatment; one at room temperature, one at 700° F.

INSPECTION REQUIREMENTS

1. Etching test on sections cut from each end of pipe.
2. Radiographic Inspection—Required complete circumferential coverage of at least an 8″ wide section at each end of each pipe in accordance with ASTM Specification E71-52.
3. Fluid Penetrant—Entire O.D. and I.D. surface each piece.

HEAT TREATMENT: Heat for 4 hours at 2100° F.—2150° F., water quench, follow by 5 hours at 1500° F.—1600° F. Cool in still air.

HYDROSTATIC TEST: Each length tested to stress of either 90% of the minimum cold yield strength or a maximum pressure of 6800 psi—whichever is lower.

SIZE RANGE AND COMPOSITION FLEXIBILITY

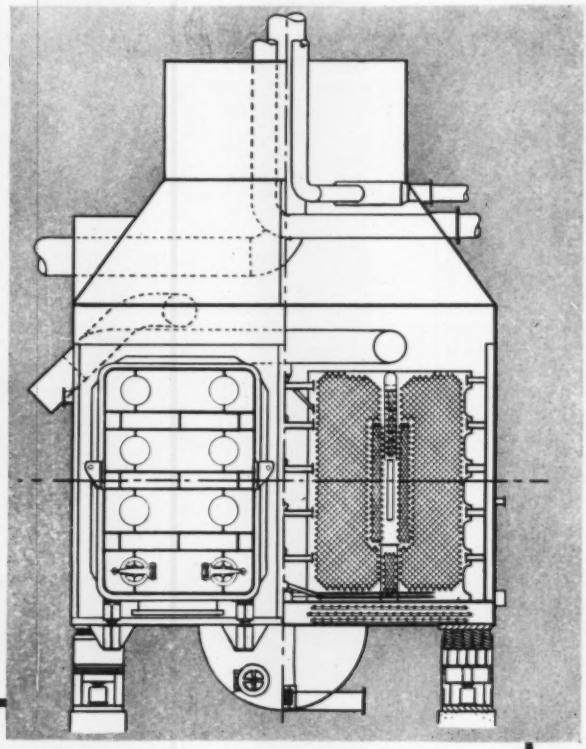
Outside Diameter—6″ to 50″
Wall Thickness—⅜″ and up
Length—Up to 16′
Types of Stainless—All Standard AISI and ACI grades of ferritic and austenitic stainless, including No. 20 Alloy, 17-4 P H, 17-7 P H and E.L.C. grades.

Modern Dual Bank Condensers Pioneered by C. H. WHEELER

For 40 years C. H. Wheeler has led in steam power plant condenser design, from the first Dual Bank Condenser introduced to this country in 1916 to the most modern design for today's huge turbine-generators.

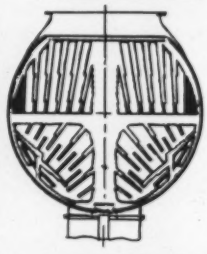
The latest C. H. Wheeler Dual Bank Condenser design for the largest metropolitan utility will provide 187,000 sq. ft. of surface to condense 1,600,000 pounds of steam per hour at 1.86 in. Hg. abs.

On the drawing boards now are new designs anticipating tomorrow's turbine requirements.

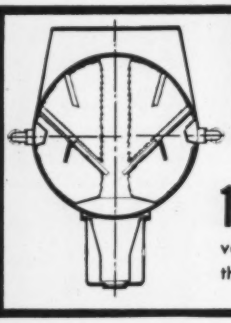


Modern Design Features..... 1956

1. **Specifically designed for today's larger, more efficient generating stations.**
2. **Adaptable to your station layout.**
3. **Lower pressure drop and higher vacuum. Additional steam lanes shorten path and resistance of steam travel.**
4. **"Zero" condensate temperature depression.**
5. **DEAERATION... 0.01 cc. per liter is attainable.**
6. **Airtight.**



1941 Additional steam lanes allowed steam to penetrate deeper. Further improvement in pressure drop. Better deaeration.



1923 Wider steam lane. Condensate temperatures corresponded to vacuum temperatures. Oxygen content less than 0.03 cc. per liter.

1916 An early C. H. Wheeler Dual Bank Condenser. Condensate temperatures approaching vacuum temperatures were achieved.

Let us tell you how our advanced designs will meet your operating requirements. Contact your local representative or

C. H. WHEELER MANUFACTURING CO., 19TH & LEHIGH, PHILADELPHIA 32, PA.

Manufacturers also of Vacuum Equipment • Marine Auxiliary Machinery • Centrifugal, Axial and Mixed Flow Pumps

C.H. Wheeler OF PHILADELPHIA

STAINLESS STEEL*

TO MARK PROGRESS

FITTINGS

1/8"

THROUGH

36"

LADISH

...FOR COMPLETE SERVICE IN *Controlled Quality* FITTINGS

When you need service in stainless and alloy fittings... regardless of material specification, size, type, or wall thickness... you can depend on the Ladish Controlled Quality line and the services of your Ladish Stainless Distributor for complete satisfaction.

IPS WELDING FITTINGS		½" through 36" From Sch. 5S to wall thicknesses through 4"
O.D. TUBING FITTINGS		1" through 36" From .049" wall to .250" wall
MSS AND ASA FLANGES		1" through 24" 150 lb. through 2500 lb.
150 LB. SCREWED FITTINGS		⅛" through 4"
FORGED SCREWED AND SOCKET FITTINGS, UNIONS		⅛" through 4" 2000 lb. through 6000 lb.

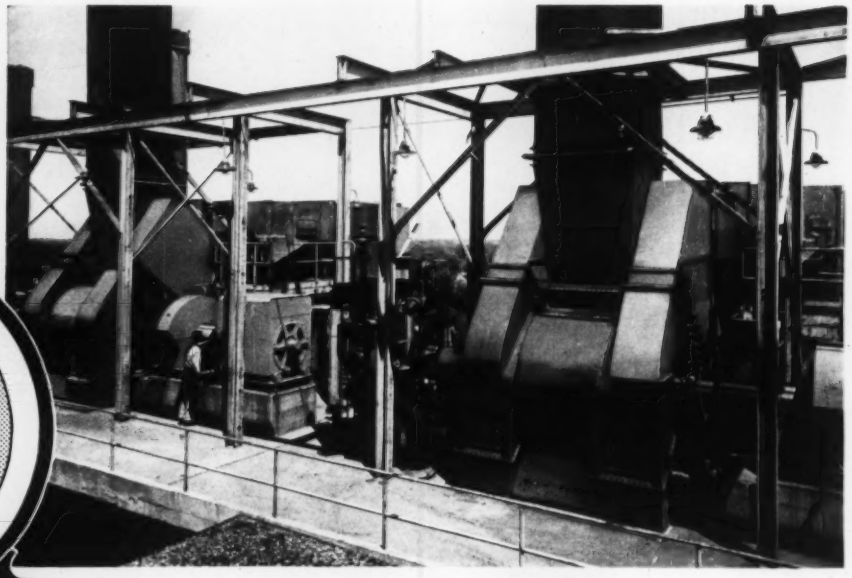
THE COMPLETE *Controlled Quality* FITTINGS LINE

LADISH CO.

CUDAHY, WISCONSIN
MILWAUKEE SUBURB

District Offices: New York • Buffalo • Pittsburgh • Philadelphia • Cleveland
Chicago • St. Paul • St. Louis • Atlanta • Houston • Odessa • Tulsa • Denver
Los Angeles • San Francisco • Seattle • Havana • Mexico City • Brantford, Ont.

*Also furnished in any forgeable material specification including... Titanium, Aluminum, Copper, Nickel, and Chromium Base Alloys.



MARATHON chooses marathon performers in the mechanical draft field

Clarage Fans Installed at Ohio Oil's Refinery, Robinson, Ill.

"Best in the long run" is Marathon's slogan for its gasoline. But there's growing opinion that these five words aptly describe Clarage equipment as well.

For example, Ohio Oil's $3,500,000 improvement and expansion program for their power plant required the removal of Clarage induced draft fans which had been on the job continuously since 1926. Think of it, nearly 30 years of service under the most punishing conditions a fan can encounter. Value received — in full!

Small wonder that two Clarage Type RT induced draft fans and two Clarage Type W forced draft fans were selected to serve the two 180,000 lbs. per hour Riley boilers in the modernized plant.

These fans are installed outdoors on an elevated platform, and are equipped with dual drives arranged for automatic control on both the turbine drive and the motor drive. The turbine is kept hot at all times so that it will start operating automatically in the event of failure of the motor, magnetic coupling, or electrical system.

If, like The Ohio Oil Company, you want marathon performers in the mechanical draft field, by all means investigate the equipment we offer. CLARAGE FAN COMPANY, Kalamazoo, Michigan.

CLARAGE ... *dependable equipment for making air your servant*

SALES ENGINEERING OFFICES IN ALL PRINCIPAL CITIES • IN CANADA: Canada Fans, Ltd., 4285 Richelieu St., Montreal

WHEREVER the JOB

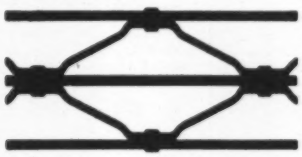
...There is an Irving Grating Sales Engineer in the area to assist you.

Specially trained consultants, stationed throughout the country, draw upon over 50 years of grating experience to show you how grating can save you time and money and improve your job, whatever it may be . . . wherever it is.

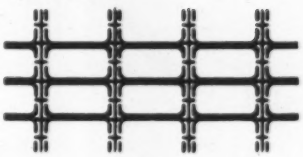
✳ We manufacture all types of industrial gratings, in steel, aluminum and other metals

From the time we founded the grating industry, in 1902, we have made an almost endless variety of applications of grating to solve numerous and varied engineering problems.

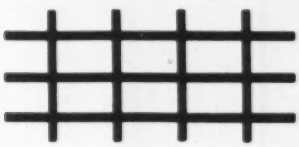
RIVETED



WELDED



PRESSURE-LOCKED



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For location of the nearest Irving Sales Engineer consult your local Classified Telephone Directory in principal cities

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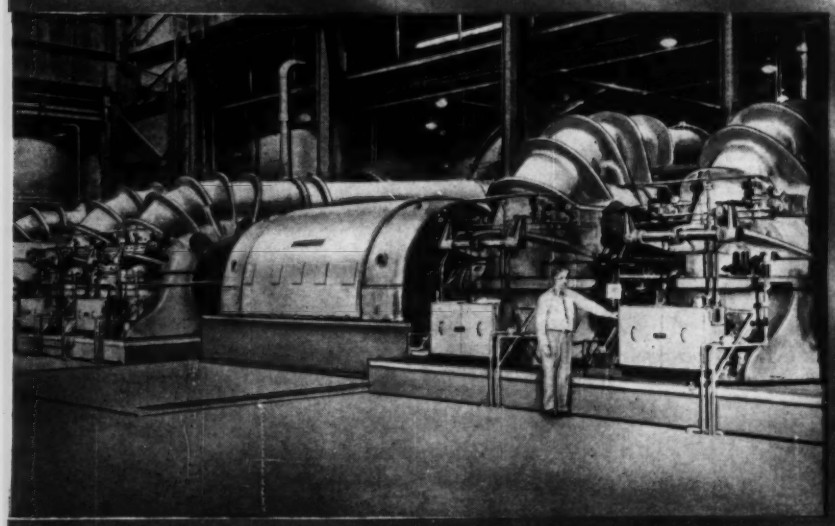
IRVING SUBWAY GRATING CO., Inc.
ORIGINATORS OF THE GRATING INDUSTRY

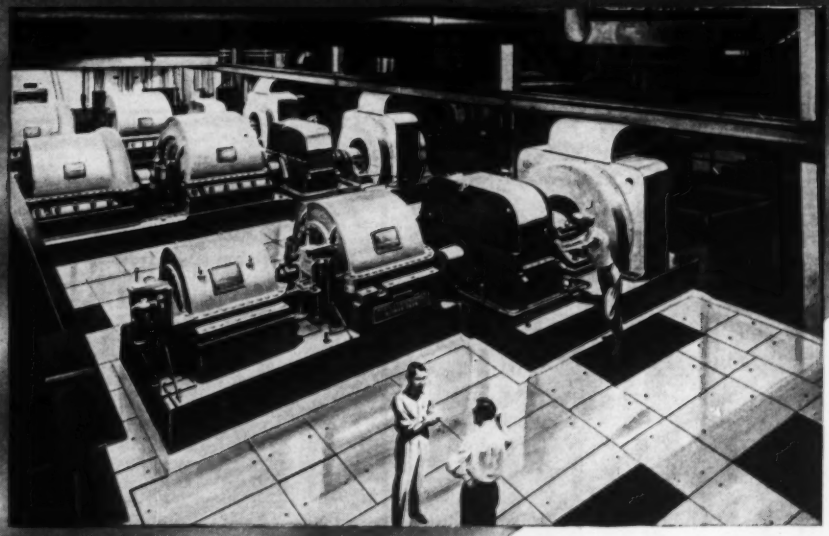
Offices and Plants at:
5010 27th St., LONG ISLAND CITY 1, N. Y.
1810 10th St., OAKLAND 20, CALIFORNIA

Representatives in Canada, Mexico and South Africa



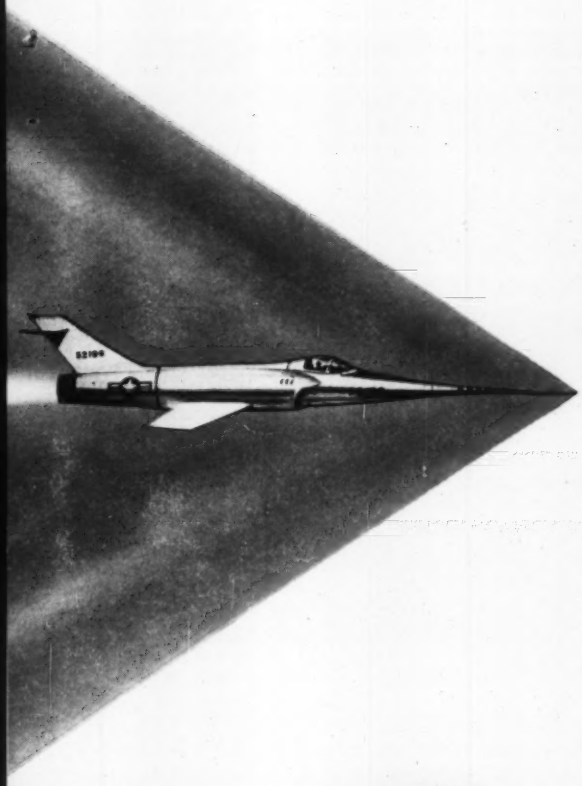
Five R-C single-stage centrifugal blowers developing over 1,000,000 cfm direct driven from electric motors rated at more than 80,000 HP at Langley Field, Virginia.

Six R-C multi-stage blowers rated over 75,000 cfm requiring about 14,000 HP, part of a centrifugal installation at Lewis Flight Propulsion Laboratory in Cleveland.



Roots-Connersville creates

STOP-AND-GO WHIRLWINDS FOR AIRCRAFT RESEARCH



Man-made air masses that match the violence of nature's hurricanes pour from the Roots-Connersville Blowers at the Lewis Flight Propulsion Laboratory of the National Advisory Committee for Aeronautics. Yet the power of these huge wind-making machines can be instantly controlled, from a soft, whispering breeze to a roaring, whirling cyclone. In the reverse, the siphoning air movement can develop almost perfect vacuums to simulate the air conditions of high altitudes. A similar but larger N.A.C.A. "wind-making system" is now being completed at Langley Field, Virginia.

The same engineering and manufacturing abilities that developed these stop-and-go whirlwinds are applied by Roots-Connersville to the everyday movement of gas and air, in small or large quantities, for industry. Now in its second century of service, Roots-Connersville Blower Division, one of the Dresser Industries, builds the world's most extensive and varied line of such equipment.

Teamwork...that serves the world!

In its specialized field, each Dresser company, operating independently, has the experience, facilities and engineering manpower to meet the progressive needs of the industries it serves. Whenever an unusually challenging problem is put before any Dresser operating unit, the vast research, engineering and production facilities of all divisions of Dresser Industries, Inc. can be swiftly mobilized into effective teamwork. Throughout the oil, gas, chemical, electronic and other industries, this coordinated performance is known as the Dresser *Plus* +...a standard of comparison the world over. *Briefacts* gives the complete story of the Dresser *Plus* +. Write for your copy today.

Tomorrow's progress planned today

DRESSER INDUSTRIES, INC.

EQUIPMENT AND TECHNICAL SERVICES

OIL • GAS
CHEMICAL
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REPUBLIC NATIONAL BANK BUILDING, DALLAS 21, TEXAS

A group of companies under a common ownership

CLARK | IDECO | DRESSER | IDECO | LANE-WELLS | Magcobar | PACIFIC | ROOTS RC | Security | SIE

GET THE BEST SOLUTION TO EVERY FLOW

. . . with Foxboro Instrumentation

Differential Pressure Cell Transmitters

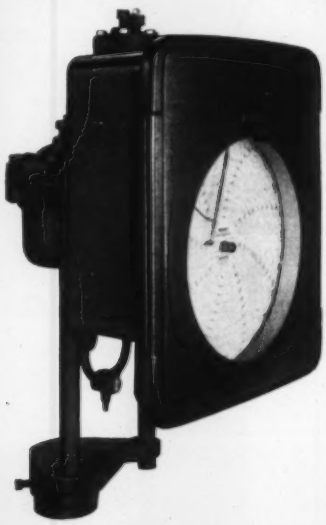
Complete line includes air-operated and electric-operated d/p Cell Transmitters covering ranges from 0-20" to 0-800" of water; working pressures up to 1500 psi.

Type 13A d/p Cell Transmitter

- Positive Overrange Protection—up to full 1500 lb. rating
- Fully Adjustable Ranges—0-20" to 0-80" and 0-50" to 0-250" water
- Automatic Internal Damping — fast, stable measurement
- Simplicity—easiest, lowest-cost installation, lowest maintenance

Mercury Type Meters

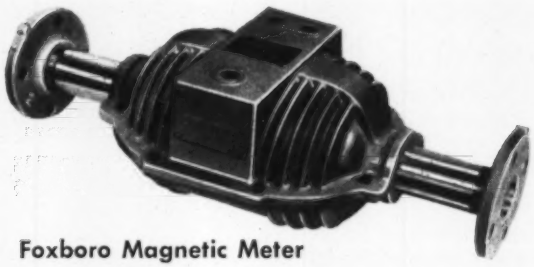
Complete line includes mercury types covering ranges from 2 to 400" of water; working pressures up to 5000 psi.



Type 28 Mercury Meter

- Permanent Full-Scale Meter Accuracy — exclusive segmental lever design provides linear transmission from float to pen
- Highest-Powered Pen Drive — large float with long travel
- Minimum Ambient Temperature Effects — float located in high pressure chamber

PROBLEM



Foxboro Magnetic Meter

- Measures Fluid Velocity Directly
- Adds No Pressure Drop
- Uniform Flow Scale
- Overall Accuracy Better than 1% of Range Over Entire Scale
- Full Accuracy Sustained Even on Liquids Other Meters Can't Handle — even sand and water slurries

THERE ARE two logical reasons why Foxboro Instrumentation assures you *optimum* results in measurement or control of process fluid streams. First; Foxboro offers the widest variety of measuring and controlling devices . . . the *right* equipment for every application. For example, only Foxboro offers all these basic meter types: differential pressure cell flow transmitters, magnetic meters, mercury meters, and weir meters. Second; Foxboro provides 45 years of engineering experience in every phase of fluid mechanics. From the simplest general utility-type instrument to complex automatic ratio control systems, you get highest accuracy, efficiency, and economy. Whenever you have a flow problem involving liquids, vapors, gases, or slurries — in pipes, ducts, or channels, you can solve it best by specifying Foxboro. Only a few instruments are described on these pages. For full details; or for specific information on *your* problem, contact your nearby Foxboro Field Engineer, or write **The Foxboro Company, 969 Neponset Ave., Foxboro, Mass.**

FOXBORO

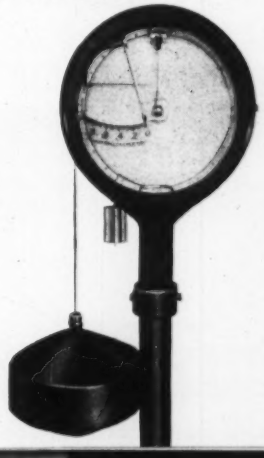
REG. U. S. PAT. OFF.

FIRST IN FLOW

FACTORIES IN THE UNITED STATES, CANADA, AND ENGLAND

Float-and-Cable Type Meters

- Rigid Construction — weather-tight case; all working parts of corrosion-resistant materials
- Powerful Accurate Operation — large, high-stability float; cable of Type 302 Stainless Steel — non-stretching, non-twisting
- Direct Reading Chart and Scale
- Direct Reading Integral Counter



Other Foxboro Flow Instrumentation

Electric or Pneumatic Type Rotameters

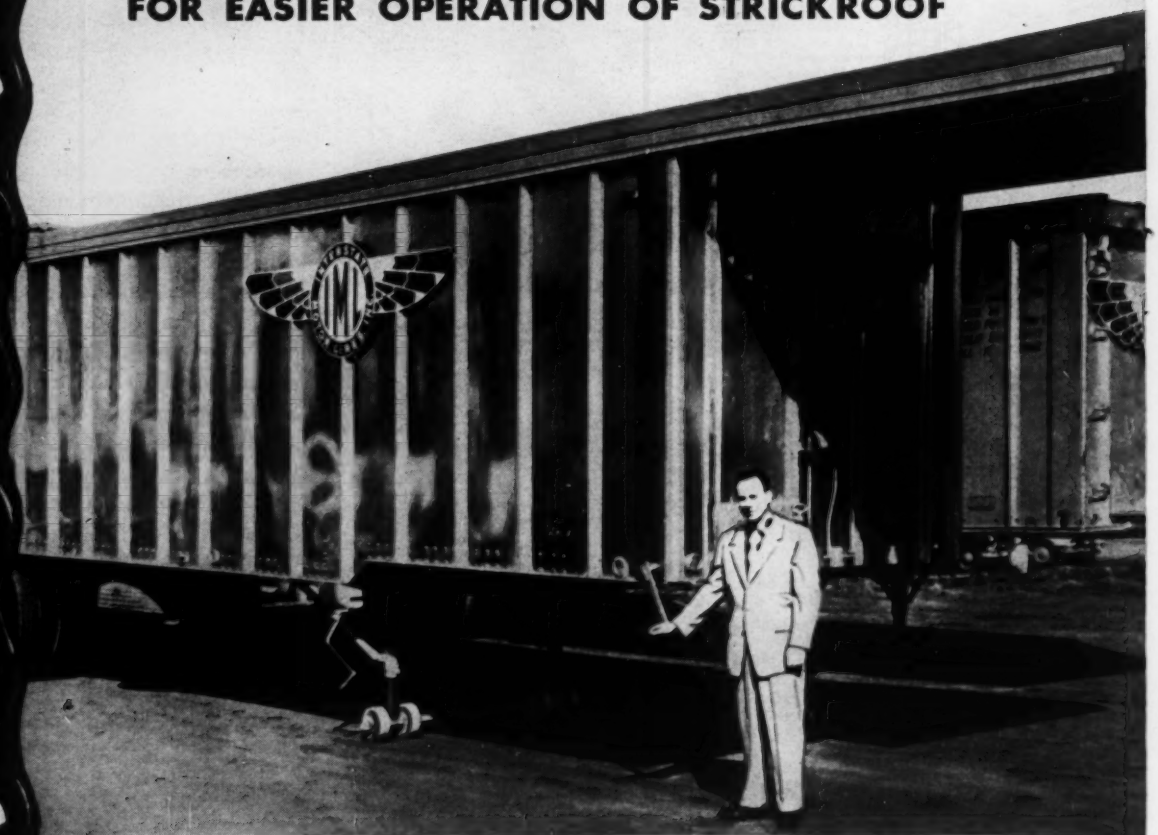
Electric, Pneumatic, and Mechanical Integrators

Planimeters

All Primary Elements, Valves, and Accessories required for assembly of complete flow measurement and control systems

FOR SMOOTH ROLLING

STRICK TRAILER CHOOSES ATLAS CHAIN FOR EASIER OPERATION OF STRICKROOF



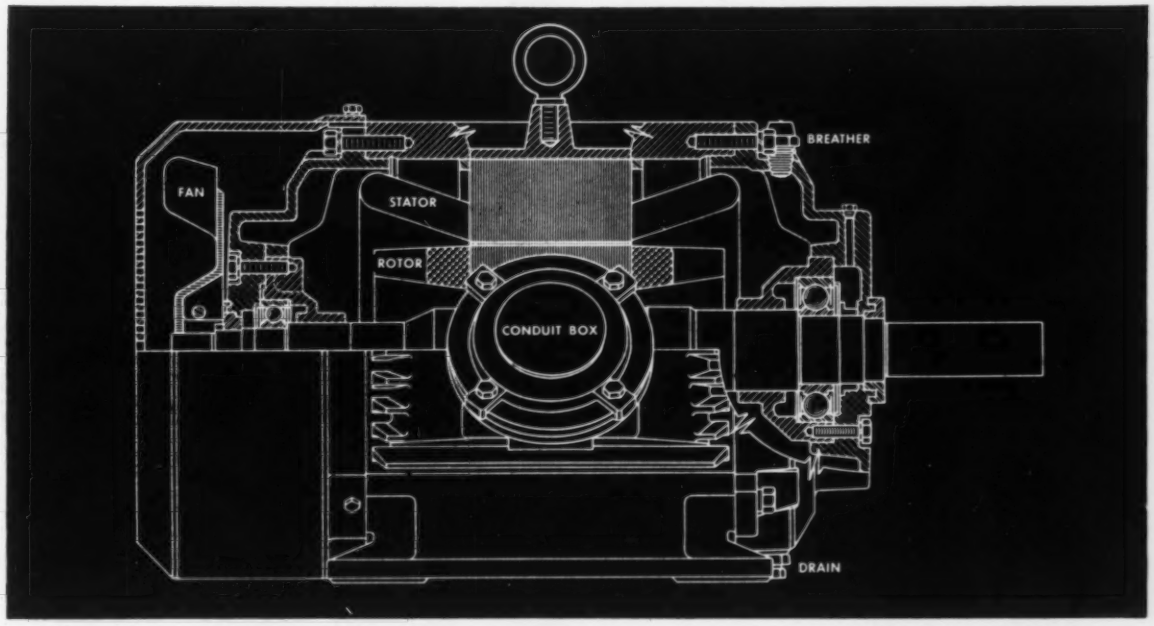
An easy turn of the handle and the roof of this Strick Trailer slides forward or backward with the help of Atlas Roller Chain. The Trailer can be loaded from the top as an open van, the roof rolled back and it is ready for the road. Its easy action is typical of Atlas Chain because each and every part is precision-made for smoother action and extra service.

Long life starts with Atlas specially selected steels. Plates, pins and bushings are super-toughened by heat treating and the Ni-Carb process which give a stronger, better operating chain over longer periods.

Rollers, pins and bushings are "Micro-Finished" to exact tolerances. Sprockets heat treated for toughness are precision-ground for smooth, quiet operation with Atlas Chain. Both the chain and the sprockets are carefully pre-tested at more than 30 points in production to assure you of chain unsurpassed in quality and performance. Whatever your chain or sprocket need, call on Atlas. Write for Atlas Chain and Sprocket Handbook ARC-56 to Atlas Chain & Manufacturing Co., West Pittston, Penna.

ATLAS

ROLLER CHAIN AND SPROCKETS



THIS MOTOR CAN CUT YOUR HAZARDOUS ATMOSPHERE INSURANCE COST

Insuring facilities with electric motors in hazardous atmospheres is generally expensive or impossible without special motors. Reliance has developed a completely new, Underwriters' approved motor design, called explosion-proof, for hazardous locations. In fact this is the only motor design that meets all qualifications for class I, group D and class II, groups E, F and G without requiring modification.

This new motor incorporates all of the outstanding features of the standard Reliance Totally-Protected Motor. In addition, all Reliance Explosion-Proof Motors are built to corrosion-proof standards.

If you would like to have more information on what qualifies a motor for hazardous atmospheres, write for our new Explosion-Proof Motor Bulletin No. B-2409. B-1526

NATIONAL ELECTRICAL CODE CLASSES OF HAZARDOUS LOCATIONS

CLASS I — Those in which flammable gases or vapors are or may be present in the air in quantities sufficient to produce explosive or ignitable mixtures.

Group D — Atmospheres containing gasoline, hexane, naphtha, benzine, butane, propane, alcohols, acetone, benzol, lacquer solvent vapors, or natural gas.

CLASS II — Those which are hazardous because of the presence of combustible dust.

Group E — Atmospheres containing dust of aluminum, magnesium, or their commercial alloys.

Group F — Atmospheres containing carbon black, coal or coke dust.

Group G — Atmospheres containing flour, starch or grain dust.

RELIANCE *Totally-Protected* MOTORS

RELIANCE ELECTRIC AND ENGINEERING CO.

DEPT. 299A, CLEVELAND 10, OHIO • CANADIAN DIVISION: WELLAND, ONTARIO

Sales Offices and Distributors in Principal Cities

Three 125,000 #/HR STEAM GENERATORS by Vogt AT LION OIL COMPANY'S BARTON CHEMICAL PLANT

★ The new $30 million Lion Oil Company's Barton Chemical Plant at Luling, La. produces 300 tons daily of essential nitrogen fertilizer materials to boost crop yields and reduce unit production costs on the nation's farms.

PRINCIPAL DATA, EACH UNIT

125,000 pounds per hour capacity.

Fusion welded steam and water drums designed for 725 lbs. S.W.P.

Superheater delivers steam at 750°F. total temperature.

Water cooled furnace.

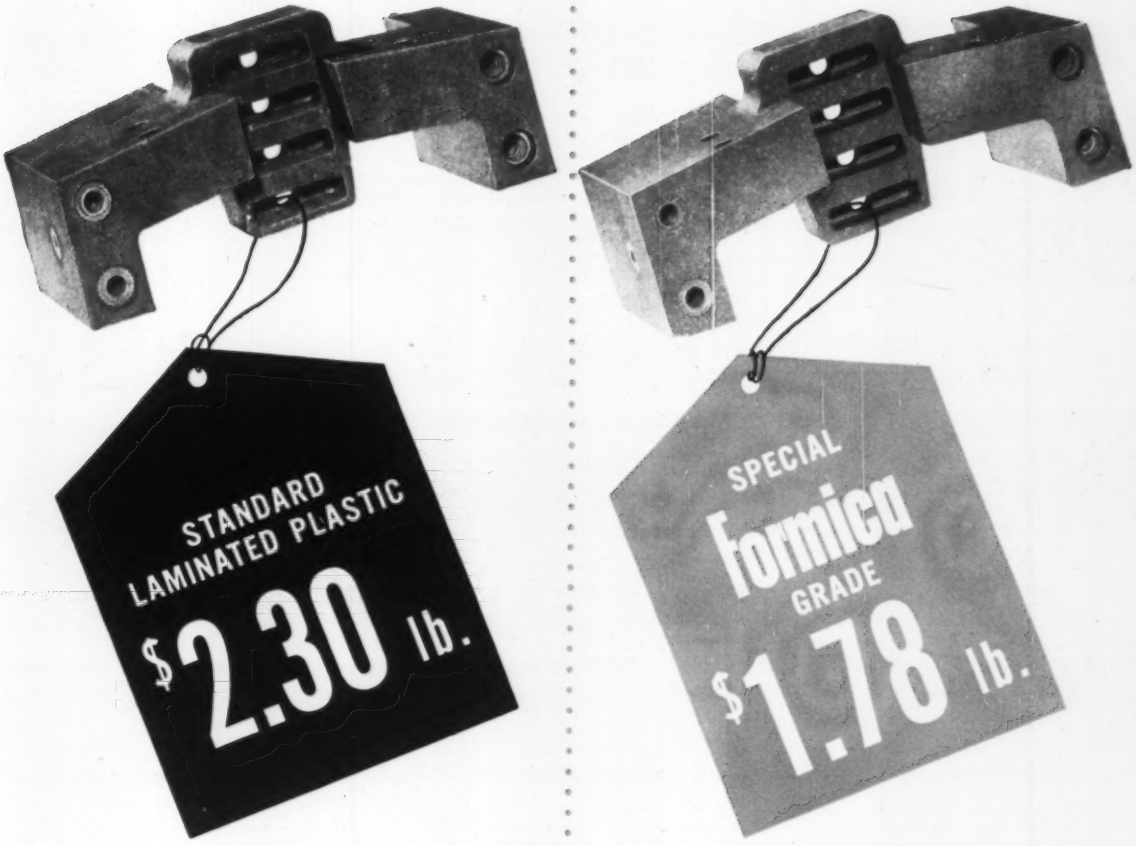
Burners for Gas and Oil fuel.

Vogt offers a complete line of custom built type and package unit type steam generators. Available in bent tube types and straight tube, forged steel sectional header types for solid, liquid, or gaseous fuel burned singly or in combination. Write for bulletins. Address Dept. 24-BM.

Henry Vogt Machine Co., Louisville, Ky.

BRANCH OFFICES:

New York, Philadelphia, Chicago, Cleveland, St. Louis, Dallas, Charleston, W. Va., San Francisco



HOW Formica IMPROVED FABRICATED PART PERFORMANCE AND SAVED 23%!

Formica studied performance requirements, developed a special grade, produced a better part, and saved the customer 52c a pound.

Are you buying laminated plastic properties you don't need? Or are you paying the penalty of poor product performance because you've been short-changed on essential properties?

You can never be sure until you have a Formica fabricating engineer check your performance requirements. Tell him what you need, where and how you'll be using your fabricated part. Then he'll select the *one grade* that's best and most economical for you.

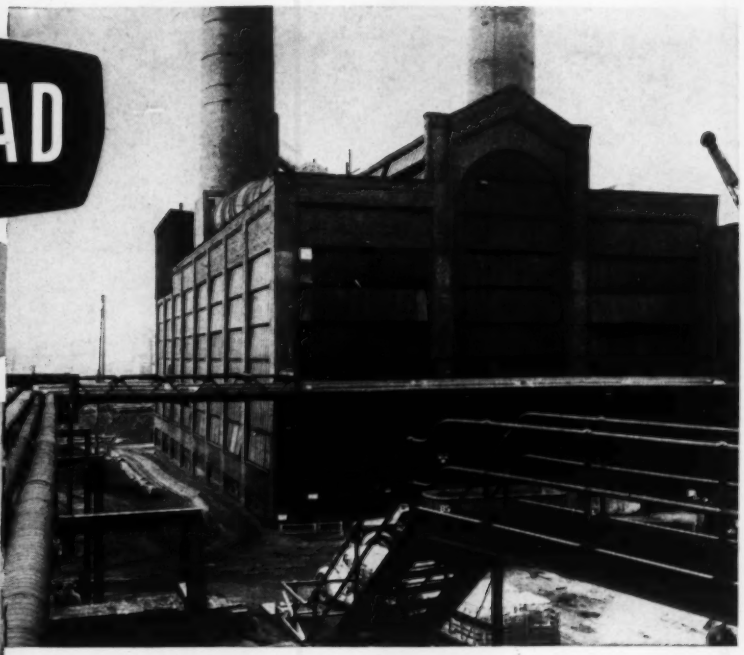
With 52 standard grades, and a competent research staff to develop special new ones, there's never any compromise with grade selection at Formica. And design modifications recommended by Formica fabricating engineers will further help to produce a better part, frequently at big savings.

This fabricating service is part of Formica-4, designed to give you the best grade at lowest cost for your application. Call your Formica district office or send us your blueprints and your performance requirements. Formica Corporation, subsidiary of American Cyanamid, 4611 Spring Grove Ave., Cincinnati 32, Ohio.

Your *blueprint* tells only *half* the story...

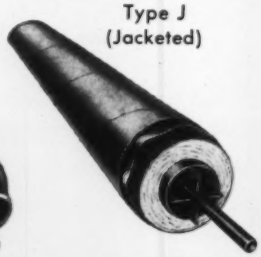
... tell us your performance requirements and we'll save you money

OVERHEAD
OR
underground



Ric-wiL offers the COMPLETE quality line of prefabricated piping systems

Ric-wiL factory prefabricated piping systems, *timed* to your schedule and *shipped* directly to the job site, can save you valuable time and money. Insulated units are available for steam, hot water, oil, other viscous fluids, process liquids and refrigeration lines . . . and remember . . . Ric-wiL is the quality system of exceptionally high mechanical strength and thermal efficiency.



Quality Piping Systems . . .
. . . of Exceptionally High Thermal Efficiency

RIC-WIL PREFABRICATED INSULATED PIPING SYSTEMS

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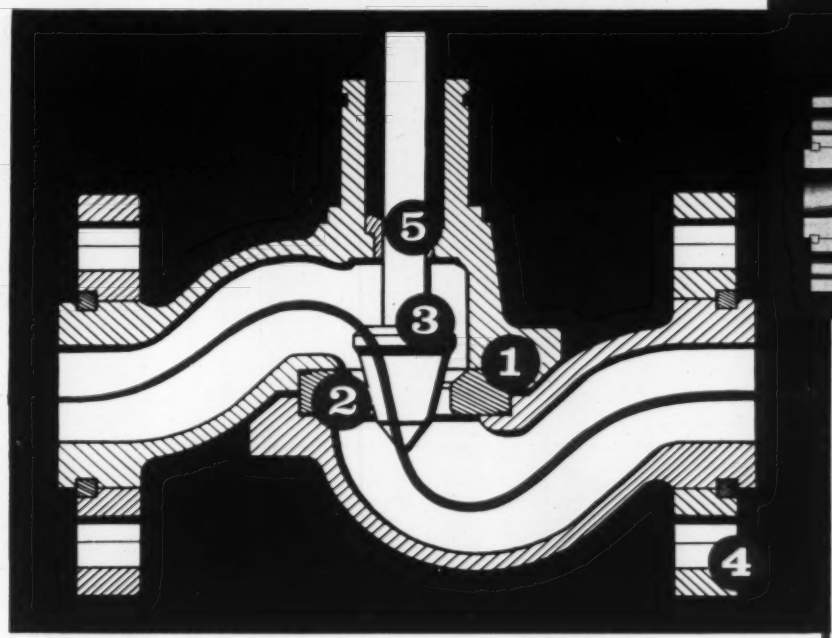

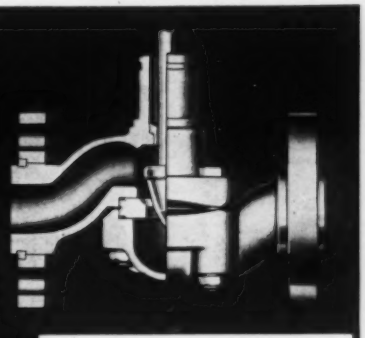

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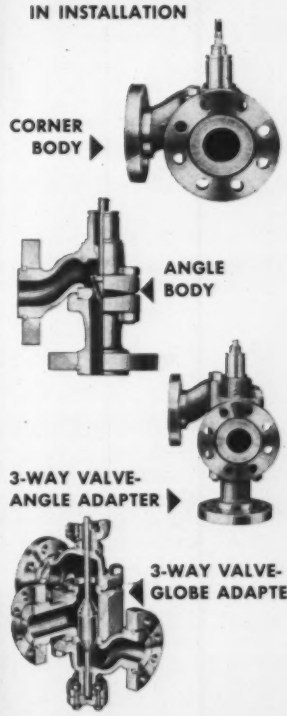

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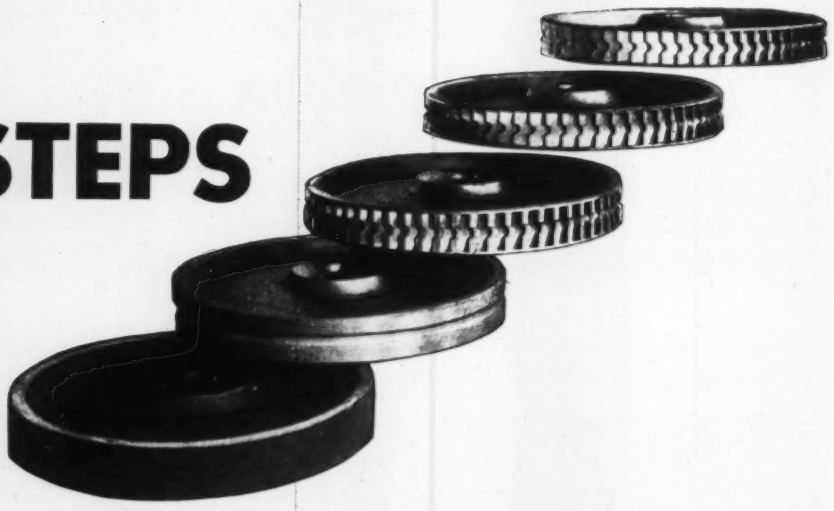

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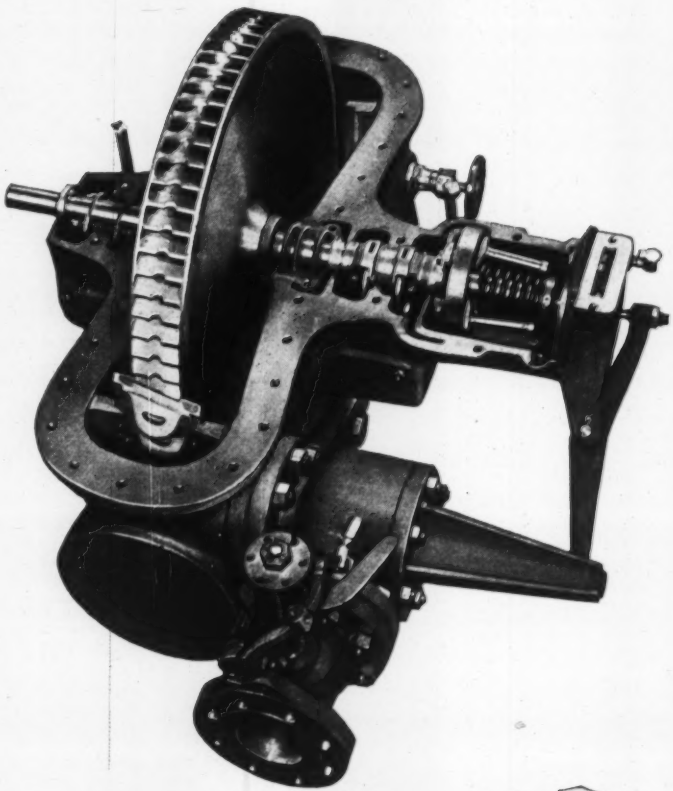

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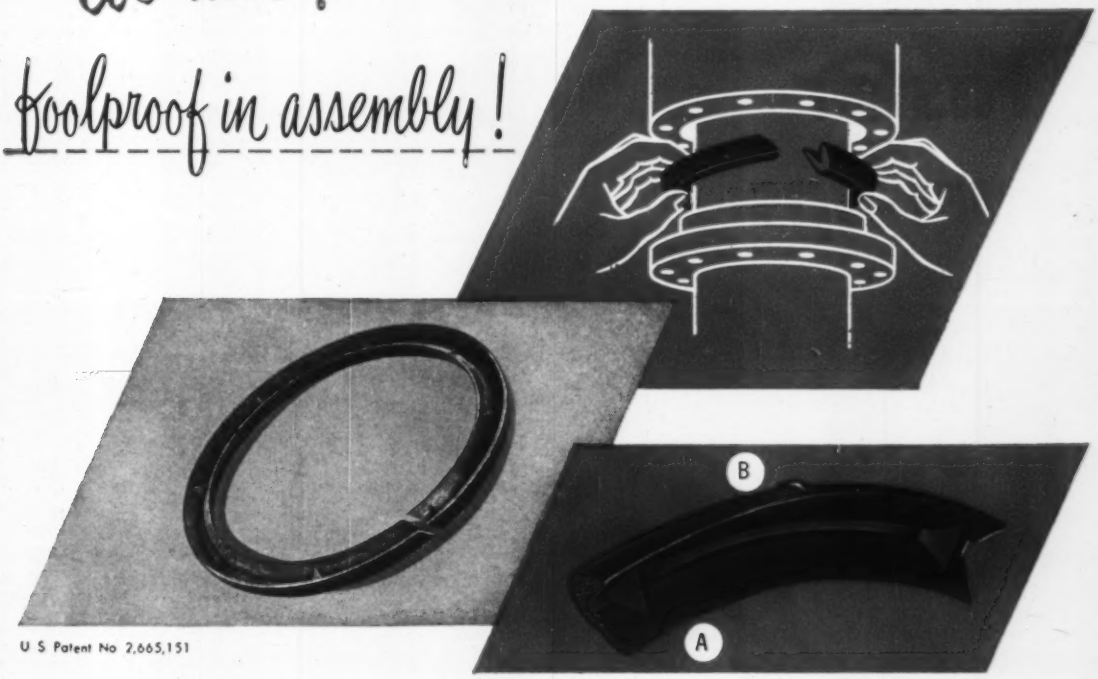

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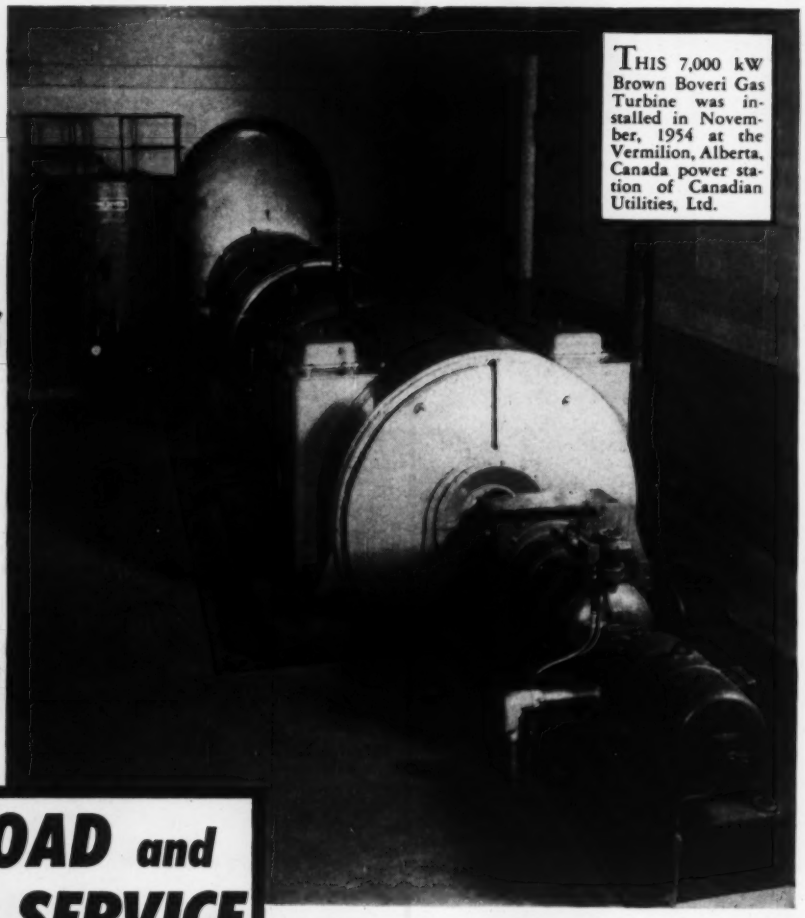

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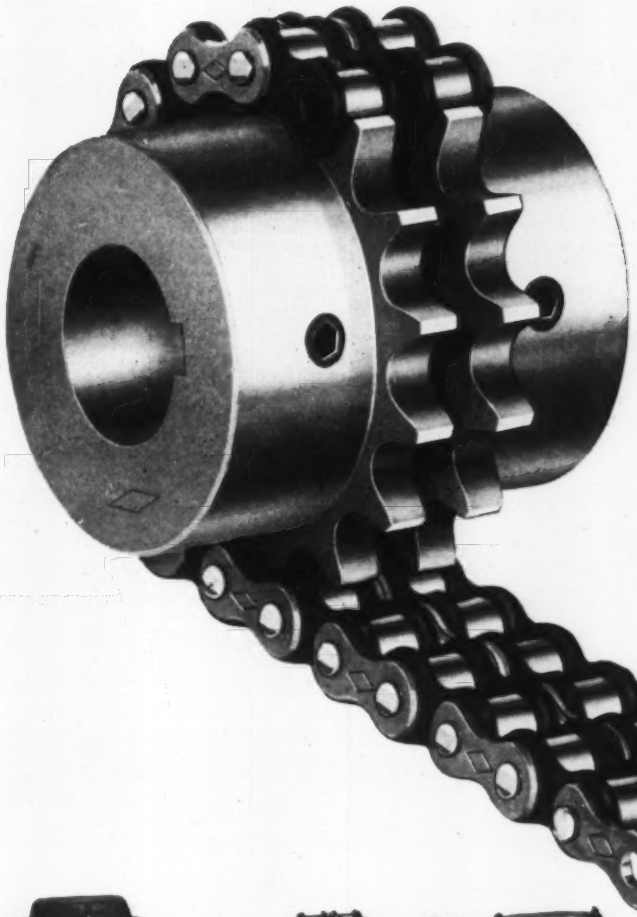

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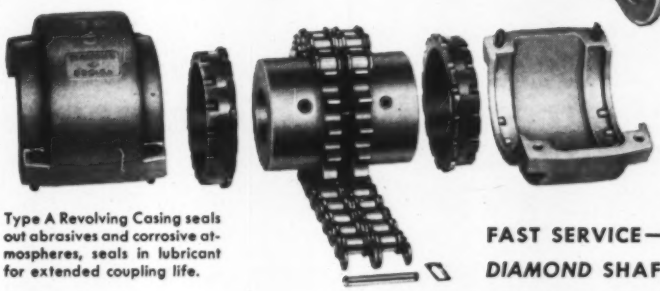

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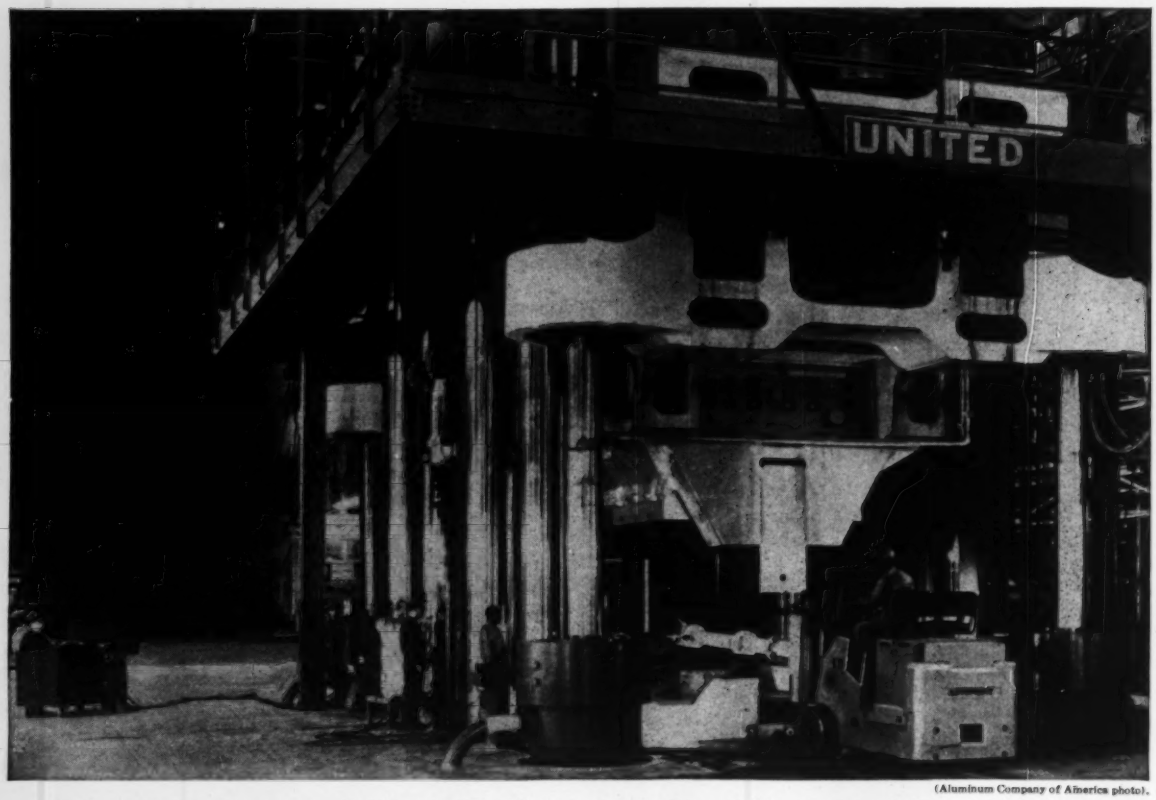

(Aluminum Company of America photo).

At one stroke this press can forge pieces 10′ wide or 24′ long. It can change a 2,000-pound aluminum slab into a complicated aircraft component... saving material as well as machining and assembly time. Cast and forged nickel alloy steels provide the strength and toughness needed in columns, cylinders, die-block holders and dies of this giant machine. Among the first of the facilities in the U. S. Air Force Heavy Press Program, this unit is a notable engineering achievement of United Engineering & Foundry Co., Pittsburgh, Pa.

Nickel alloy steels strengthen huge press for 35,000-ton squeeze

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SEPTEMBER 1956

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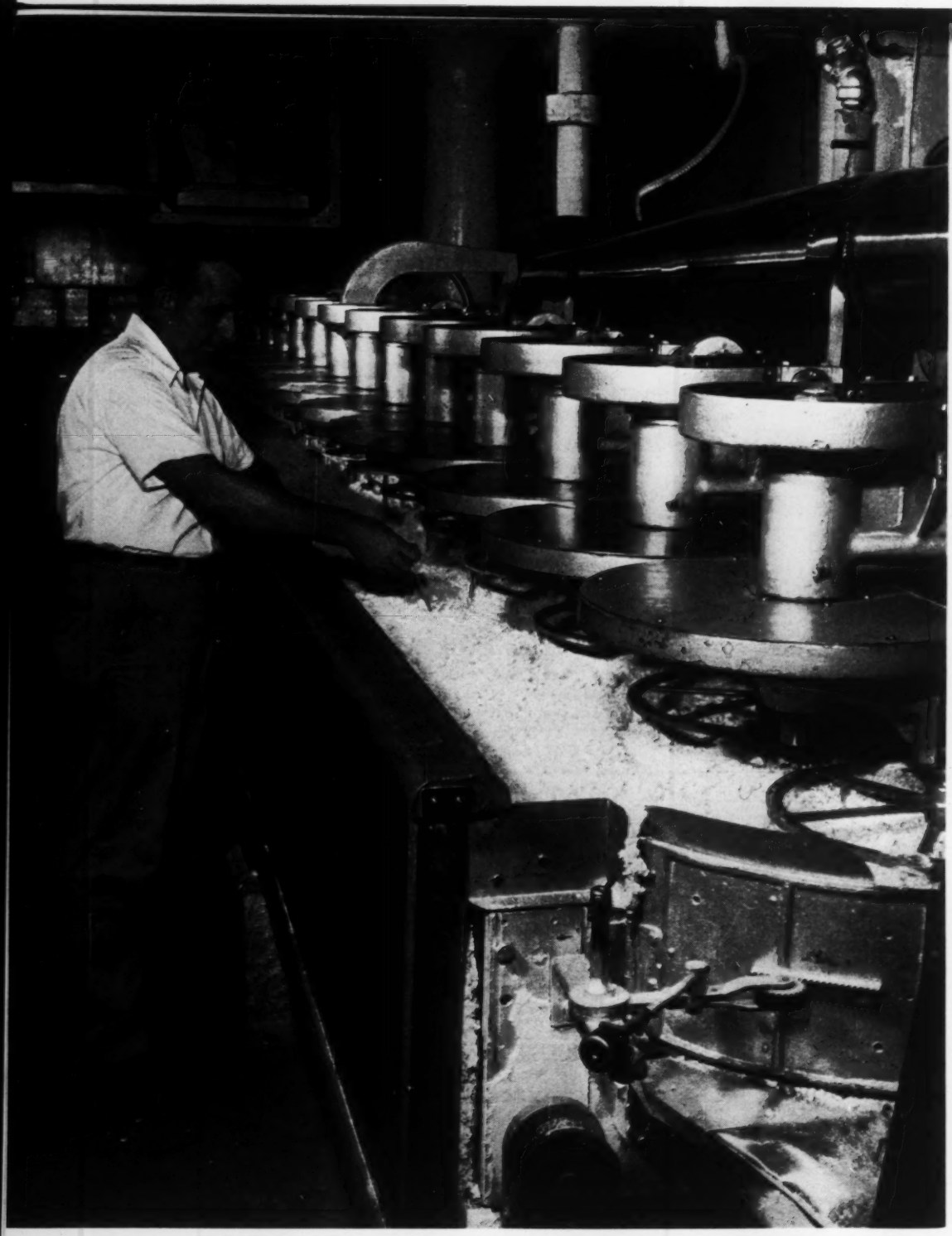

This steam-jacketed continuous-process machine . . .

. . . has been developed by General Foods Corporation for making minute tapioca in larger volumes. The machine controls the continuous cooking of tapioca which is essential to its manufacture. For details on other recent advances in food technology see pages 802–814 in this issue.

Volume 78 • Number 9

SEPTEMBER 1956

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George A. Stetson, *Editor Emeritus*
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MECHANICAL ENGINEERING

"The Prof"

THE Prof, as we on the ASME staff have affectionately come to know George A. Stetson, officially relinquished his post as editor of The American Society of Mechanical Engineers on July 2, 1956. As editor emeritus of ASME, he will continue to perform a wide variety of duties, either in toto or in a consulting capacity. For example, among his future plans, is the tremenduous task of writing the history of ASME. All of which means that in the future as in the past we can count on his sound advice, wise counsel, and broad perspective with the same depth of vision that his clear thinking has offered regarding matters engineering and matters ASME.

This is as it should be. For the Prof has made the ASME his life's work—in particular its publications. In fact as early as 1918, while still teaching, he became editor of the Transactions. He carried on this work concurrently with his educational activities until 1928 when he became a full-time member of the ASME editorial staff. In 1930 he was appointed editor of ASME publications. Always and still a master of both the written and spoken word, he has contributed greatly to the development of MECHANICAL ENGINEERING and other ASME contributions to the technical literature.

His quiet dignity and high ideals, combined with his wide knowledge of the humanities, education, civic affairs, and engineering in general, have been the cornerstone of ASME publications. These qualities have made themselves felt in many other avenues of ASME activities as well. For example, his comprehension of the aims and purposes of the Society has, over the past 40 years, made his services to the officers and members of the Council and committees of ASME invaluable; and he will continue to serve them unselfishly in his new capacity.

His services to the Publications Committee, which, under the direction of the Board on Technology, has supervision of all publications within the purview of the Board, have been legendary. Specifically, these publications include the periodicals of the Society, the publications that result from the work of the professional divisions and research activities, and such other publication responsibilities as may be assigned to the Committee by the Council or the Board on Technology.

Over the past two years, he has worked constantly with the Publications Committee on a study of all facets of the problems concerning the publication and distribution of Transactions of the ASME, including various proposals for grouping Transactions papers. A progress report on the Committee's findings will be made to the Board on Technology before December, 1956, and will cover the foregoing plus a host of other projects which the Committee has under consideration.

Under his guidance and excellent tutelage we have in the recent past improved the format of MECHANICAL ENGINEERING in an attempt to make it more attractive. Many of the feature articles are now being condensed and rewritten for easier reading. We have added the "European Survey," which is designed to keep ASME members abreast of engineering progress in the British Isles and Western Europe. A monthly photo-feature section also has been instituted.

In an effort to provide a still better service to our readers we have recently split the "ASME News" down the middle—providing in effect a true "ASME News" and adding a new department, the "Roundup," which will cover general or non-ASME news on engineering and the engineering profession. This new department started with the July issue and it is designed to provide ASME members, in one place, with a good general roundup of news and events related to mechanical engineering, but outside the immediate activities of ASME.

Looking to the future, with George Stetson's teachings and sound judgment as a guidepost, we will strive for a still greater variety of concise feature articles. This is extremely important because of the great diversification of our members' interests, and additionally necessary to keep pace with the great technological expansion that has been taking place and will continue to take place in our engineering and scientific world.

Departments, such as "Briefing the Record," "European Survey," and "ASME Technical Digest" have been undergoing study. Of these the "Digest" has been singled out for immediate improvement. This is being done by preparing better, more informative, digests of available ASME meetings papers.

As more editorial staff becomes available, other improvements will be implemented.

Thus, with the "retirement" of the Prof—gentleman, scholar, and distinguished engineer—we inherit the solid foundation upon which he built our publications. Before us lies the opportunity to take full advantage of that foundation toward increasing the Society's publication services to the membership and the engineering world in general.

Recent Advances in Food Technology

Antibiotics and Irradiation among latest developments in the preservation of food

By Aksel G. Olsen and Daniel A. Mills

Central Laboratories, General Foods Corporation, Hoboken, N. J.

This grocery store of 1920 vintage is a far cry from today's gleaming modern store with its shelves loaded with products to meet consumers' demand for less kitchen work and more convenience in preparation. (Photos courtesy *Progressive Grocer*.)

Food technology has been defined as the application of science and engineering to the production, processing, packaging, distribution, preparation, and utilization of foods. In this sense, it covers everything from hybrid corn and Beltsville broilers to sterilization by irradiation and selection of base steel for tin cans. It covers nutrition studies on finished foods, as well as engineering problems in their production.

Food Engineering. Recently, there has grown up within the field of food technology a more restricted field of food engineering, which has been defined as follows:

"Food Engineering is concerned with the design, construction, and operation of industrial processes or plants in which controlled physical, chemical, and biological changes in food may occur. . . ." (Milton E. Parker, Elements of Food Engineering.)

The food engineer may be concerned with the design or operation of a milk plant, a soluble-coffee plant, a cannery, a frozen-foods plant, or a brewery. In any event, his ultmate concern is the controlled production of a food product satisfactory to the consumer at a cost permitting competitive marketing at a profit.

From the American consumer's standpoint, the most important attributes to look for in a food product are palatability, economy, convenience, and, of course, nutrition. Accordingly, these also provide a yardstick by which the food manufacturer must measure his products against his competition.

Aim of the Food Technologist

The food technologist utilizes every branch of science available to him to develop for the consumer the kind of food products that he or she wants and to insure continued improvement in quality, convenience, and economy. The "service-to-consumer" concept is the all-permeating ingredient, the leavening which activates and directs the activities of the food technologist wherever he is employed and regardless of whether his major contribution is as an organic chemist in the field of flavor development, a biochemist checking the nutritional values, a product-development man utilizing his general scientific knowledge, or a chemical engineer designing a new process to put the new or improved product into commercial production. All these are separate facets of food technology, each facet supplying an essential part of the total endeavor necessary to insure progress in the development of consumer food products and increased consumer satisfaction.

Changes in Food Industry. The past 50–60 years have seen tremendous changes in the food industry. The period about the start of the century saw a very rapid increase in so-called "packaged" products, breakfast cereals, and so on. In the 20's came the quick-freezing of foods, and both world wars served to stimulate dehydration, mainly for field rations. Civilian use of dehydrated products is largely a postwar development.

In 1942, R. C. Newton (1)[1] made the observation that fundamentally there are only a few methods of food preservation. These can be classified as (*a*) drying, (*b*) salting-pickling, (*c*) chilling or freezing, (*d*) chemical preservation, (*e*) heating or hermetically sealing and heating, and (*f*) inhibition of oxidation by packaging or use of antioxidants.

New Developments. There had been at that time no speculation about the use of either antibiotics or irradiation for sterilization purposes. However, by 1948, when A. G. Olsen (2) reviewed the recent advances in food technology, several forms of radiation were mentioned.

Now in 1956, this latter subject has received so much attention that it has given several areas of the food industry a severe case of jitters, and the use of antibiotics has recently become commercially introduced and has been accepted by the Food and Drug Administration for limited use.

[1] Numbers in parentheses refer to the Bibliography at the end of the paper.

Progress in other areas of science may and often does lead to new developments in food technology; however, a review of recent developments in the food field leads to the conclusion that these have been influenced far more by the consumer's demand for convenience than by new developments in science. Even a cursory look at today's grocery shelves shows them loaded with products which are there in response to the consumer's demand for less kitchen work and more convenience in preparation.

In this paper, our intent is to cover only major advances in the field of food technology, specifically those related to so-called consumer products as marketed directly to the consumer through the grocery stores. It is not within the scope of a limited paper such as this to cover more than selected topics.

Beginning of Food Technology. Food technology is a recent science in the sense of being an organized field of knowledge, but has evolved out of a very ancient art. Probably a suitable date to honor as the birth of food technology is the year 1800; it was about that time that Nicolas Appert, a Frenchman, made his discovery of the process of preservation by canning. However, almost a hundred years passed before Samuel C. Prescott and William L. Underwood in 1895 put canning on a safe and reliable basis by applying the science of bacteriology to the spoilage problems of the industry.

There is still a considerable amount of art connected with cooking, whether it is practiced in the kitchen at home or on a mass scale in the factory; however, at an ever-increasing rate, the basic disciplines of science are being applied to the production and improvement of prepared foods. Maybe the most recent frontier to be partially explored and covered by a scientific discipline is that of taste testing. No longer does the VP in charge of sales, as an individual, determine what will satisfy the consumer. Acceptability is now determined by applying the careful thinking and effective techniques of modern statistics to the opinions expressed by groups of consumers. Admittedly, there is still much to learn in this field, but each year we come closer to an objective and dependable method for measuring consumer acceptability.

Advances in Product-Evaluation Techniques

The importance to the food industry of recent advances in flavor evaluation and food-acceptance testing may be illustrated by an example of a fiasco that has occurred many times in the past. This particular description and the names used are fictitious.

A manufacturer, seeing an opportunity to develop a profitable business during a period of rising coffee prices, wanted to start production and sale of a coffee substitute and sponsored a research project to develop the product. John Jones, a food technologist, was assigned to this project. John and his group proceeded to roast and blend a variety of raw and processed grains and other ingredients. They checked the brewed beverages by comparison with coffee samples picked up in local markets. The group developed a preparation which they liked because, to them, it had a strong resemblance to one of the several competitive brands of coffee they had used for standards of comparison.

The sponsor personally did not like John's sample, but reflecting on the technical competency of the research team he accepted their judgment, and their recommendation to proceed with his market plans.

Several thousand cases were moved during the introductory period, but repeat sales lagged, and after 10 months and a considerable financial loss the new product was discontinued and written off as a failure.

Flavor profile panels at Arthur D. Little, Inc., Cambridge, Mass., work under controlled conditions and use standardized techniques of tasting and smelling. Here a panel is profiling a sample of a hot beverage, which is tasted at a predesignated temperature (note the thermometers in the porcelain cups).

Today, such an enterprise would have available a number of test procedures for auditing the probability of successful consumer sales before serious commitments to production and advertising were needed. The techniques recently developed can be discussed under four general categories.

1 *Scientific selection of a taste panel* can be employed to eliminate those who are physiologically poorly equipped to perceive the taste sensations important to the product (the "taste blind"). By repeated tests of a taster's ability to choose the odd cup out of a group of three (the triangle test) the tasters can be screened or evaluated for acuity and accuracy. By using cups of varying degrees of difference, the test can be used to arrange prospective tasters on a scale which denotes their relative acuity based on their relative successes in identifying small taste differences.

2 The same test can be used in the reverse sense, *to assess the degree of difference between a test sample and a control.* The test sample may be an experimental product of research to be compared with a competitive or "target" control—as in the case of John Jones' coffee substitute and coffee—or the test sample may be taken for routine test of uniformity against a quality standard. In either case, one of the samples is presented in duplicate and the other singly, all under blind code for identification of the odd sample. A quantitative statistical relation can be established between the degree of difference in flavor to be detected, the number of tasters participating on the panel, and the risk one is willing to take of a false assessment of the difference. This technique of panel testing for difference rests on the same mathematical basis as statistical quality control. It turns out that John Jones and his three assistants have a negligibly small chance of establishing the correctness of their judgment of a reasonably small flavor difference owing to the small size of their group. Furthermore, they have no evidence to indicate whether their acuity is greater or less than the average consumer.

3 In quality control of production it is usually sufficient to merely establish a significant difference from standard quality to warrant rejection, but when the problem is one of new product development or product improvement toward a more remote goal, it becomes important *to describe the several flavor characteristics involved* and to identify those which are mainly responsible for the differences found. For this purpose a new tool has been established and standardized by Arthur D. Little, Inc., which is called the "flavor profile" (3). Basically, the procedure rests on (*a*) careful screening of panel members for native acuity and interest, (*b*) intensive training in the recognition of specific flavor and odor components, (*c*) training in recognizing the sequence in which flavors are perceived (impact, aftertastes) and their counterpart, "body," which results from simultaneous perception, (*d*) provision of specific examples of separate attributes, e.g., bitterness, astringency, smokiness, and so on, for uniform reference by each panel member, and (*e*) uniformity of terminology leading to a meaningful panel report. Such a flavor-profile panel probably would have been able to tell John Jones that his coffee substitute resembled a dark roast coffee in bitterness and astringency but that it lacked aroma and body.

4 Having established by means of triangle tests that an experimental product has been brought close to its target and having shown by profile tests that the remaining differences can be identified with certain attributes, it still may be difficult to estimate *how well the product would be accepted by the average consumer.* Predictions of this type are sometimes possible when the public's likes and dislikes are well known to the trade and there is no confusion in the terminology used to describe flavor reactions. Most often, however, it is necessary to supplement panel tests with preliminary small-scale consumer tests to confirm the direction in which further development of the product should proceed. Quick answers can be obtained by a sampling of several hundred customers in a large department store for "snap" preference judgments on paired samples, or it may be necessary to place the test sample and its control in a hundred homes for family evaluation under a normal meal-time environment. In either case, the tester must be aware of the difficulties in population sampling for any kind of opinions and the tentative nature of the answers obtained. However, it has been more and more evident recently that the most successful food research and development are those which are guided by the con-

sumer long before it reaches the test-market stage. The personal preferences of John Jones and his corps of technical assistants have long since been outmoded as guide lines too risky for most food research and development to afford. A corollary is that marketing plans based on a product evaluation by anything short of an adequate consumer panel are no longer acceptable.

Role of Statistics in Food Research and Development

The application of statistical techniques in the food industry is increasing as evidenced by the content of the papers in food journals and the shop talk at meetings of food technologists.

The statistical approach makes it possible to evaluate smaller differences among test products with a fair degree of accuracy. In addition, the research programs and the collecting of the data are planned so that with less time and effort one is able to draw more conclusions. The fractional factorials illustrate the type of design that makes efficient use of data. They are being applied in experimental situations in the food industry where many factors must be studied at one time. Typical examples are studying the relative influence of the ingredients in a formulation for a new product, determining the effect of a number of processing variables on the rate of production, and comparing the protective qualities of various packages.

New statistical designs are currently being used to determine the conditions for obtaining an optimum response. This technique is referred to as the exploration and exploitation of response surfaces. It is applied when there are numerous quantitative factors that have a simple functional relationship to the response or responses that are being measured. In a chemical process it might be the relationship of the yield, purity, and cost to such factors as temperature, pressure, concentration, proportion of reactants, and so on. In a food product all variables ultimately must be evaluated in terms of consumer acceptance.

The advent of high-speed computing machinery gives promise that mathematical and statistical theories will be used for determining the more complex functional relationships of variables. Examples would be the dependency of taste preference on color, flavor level, texture, temperature, and the like, or the dependency of shelf life of a package on the shape, the overwrap material, humidity, time, etc. However, it should be kept in mind that for situations in which the data can be obtained by using one of the many statistical designs that are available, then the analysis does not usually require high-speed computers.

These statistical methods represent a very great improvement in ways to handle experimental data. They are even more important when they are applied to the design of the experiment itself before collecting data. Statistics should not be used in research, however, without the use of common sense and, of course, statistics are not a replacement for common sense.

Irradiation of Foods

Food Preservation. It may be inferred from what has already been said that there has been little fundamental change in food sterilization since the canning process was devised 150 years ago; however, there has been a continuous search for improvement in canning techniques and for new methods of sterilizing food without heat.

Table 1 Effect of Radiation on Various Foods[a]

Present Estimates of Promise

Storage of perishables without refrigeration
Dose: 2,000,000 reps[b]

Good	Fair	Poor
Asparagus	Apple juice	Banana
Bacon	Apple sauce	Beans, Lima
Beans, green	Beefsteak	Cantaloupe
Beef liver	Bread	Celery
Broccoli	Cabbage	Cheese
Brussel sprouts	Cherries	Frankfurters
Carrot	Corn	Lemon juice
Chicken	Halibut	Lettuce
Cod-Fish cakes	Ham	Milk
Pork	Hamburger	Oranges
Pork sausage	Lamb chops	Orange juice
Waffles	Peas	Squash
	Spinach	Strawberry Syrup
		Tomato juice

Extension of Refrigerated Shelf Life

Dose: 100,000–500,000 reps

Beef steaks	Ham	Sausage
Cabbage	Hamburger	Salami
Cherries	Lamb	Scallops
Cole slaw	Luncheon meat	Tomatoes
Fish	Peaches	

Nonsterilizing Radiation Applications on Food

Dose: 10,000–50,000 reps

1 Destruction of parasites
2 Destruction of insects
3 Increased storage life of tubers
4 Inhibition of sugar formation in tubers
5 Suppression of bitterness in orange juice

[a] Source: Data from Activities Report No. 2, Research and Development Associates, Food and Container Institute, Inc., July, 1955.
[b] Rep is the measurement unit for irradiation; abbreviation for Roentgen Equivalent Physical.

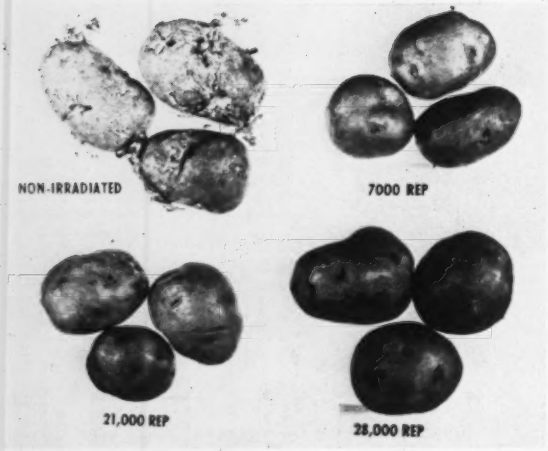
Shortly after the discovery of x rays and radium in the early twentieth century, scientists started to explore the use of radiation as a means of destroying microorganisms, but commercial application had to await the availability of radioactive by-products from the Atomic Energy Commission's reactor program and the development of high-energy particle machines. The potential availability of these large-scale irradiation facilities now suggests a revolutionary solution to this problem.

All aspects of the problem are being studied intensively, particularly under research contracts supported by the military forces. These studies include:

1 The effects of irradiation on food; bacteriological and chemical effects.
2 Toxicology of irradiated food.
3 Design of large-scale irradiation facilities.

Several of the techniques used in studies with high-intensity gamma radiation have been described by Brownell and Nehemias (4).

As yet, the basic process involved in microbial destruction is not well understood. A given dosage of radiation will not produce equivalent destruction on different organisms. Also, each food studied will respond in a different way to equal doses. That is to say, one food might survive unchanged as to taste and odor whereas another would take on altered organoleptic properties. The problem resolves itself down to the study of irradia-



Comparison of nonirradiated (sprouted) potatoes with irradiated potatoes

tion effects on each individual food product. As stated, a great deal of this type of work has been done in collaboration with, and under the auspices of, the Armed Forces. A list of a number of foods that have been used in these irradiation studies and the degree of success obtained in the initial studies is given in Table 1.

In so far as we are concerned with reduction in bacterial population, the foods in Table 1 all respond in the same general way. However, the taste and odor changes pose the big problem to be overcome in a different way for each item. For example, asparagus irradiation results in a satisfactory product after 2 million rep. Bacterial effects on product quality are minimized. Bananas, on the other hand, suffer taste and odor alterations which place them in the "poor" category. Much intensive research must be conducted before these problems are solved; however, many special applications will be possible without attempting to make the process universally applicable. In that connection, attention is called to the group of nonsterilizing applications. These are special jobs irradiation can do. A typical example is the irradiation arresting of potato sprouting at quite low doses. Improved raw-material purchasing and handling schedules are possible when sprouting is not a problem and the over-all economic advantages seem obvious. This particular process already has been tested successfully on a ton-lot basis.

Assuming successful irradiation without objectionable quality changes, there still remains the major question of whether the treatment gives rise to any toxic reactions. Extensive feeding studies are continuing on all types of irradiated product, with both animals and human volunteers. It will require some years of extensive feeding tests before irradiation is accepted as completely safe; however, as of today, we know of no toxic reaction occurring upon irradiation.

Another question is that of cost. It now appears that with increasing availability of radioactive by-products to provide the irradiation source, the processing costs appear not out of line with the benefits to be obtained.

However, before irradiation becomes acceptable practice in the food field, we must have the following:

1 Food and Drug Administration clearance on the basis that irradiated foods have been proved completely safe.

2 Consumer acceptance of the idea of eating irradiated foods.

The latter might be the more difficult hurdle.

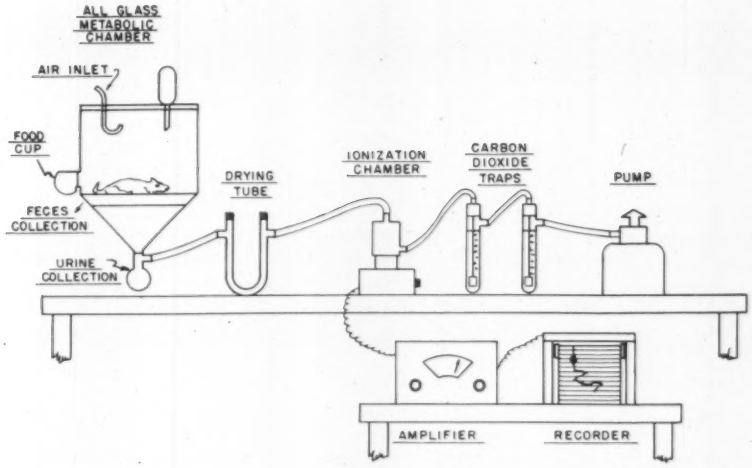
Isotopes in the Food Industry. The use of isotopes no longer can be considered a new technique in food research. However, remarkable progress has been made in recent years in finding new ways of putting radioactive isotopes to work in food research. The availability of isotopes and people trained to use them has taken the procedure out of the realm of pure research and made it almost an everyday procedure.

In the determination of the acceptability of various new additives proposed for use in foods, isotopes have proved to be extremely useful. The Manufacturing Chemists Association has estimated that it requires 2–3 years and from $100,000 to $300,000 to run a complete toxicity study on a new additive by classical methods. In many cases, by using tracer techniques, it is possible to do a more complete evaluation with the expenditure of far less time and money. By tagging the additive and comparing it where possible with a tagged chemical similar to the one under study but which is already accepted in food, a rapid evaluation becomes possible. In any event, the course of metabolism of the isotopic additive can be established after feeding to test animals. If the material accumulates in the tissues and organs, a fact which is readily demonstrated, there would be some doubt as to its innocuousness. An automatic metabolic apparatus has been used in such work. Animals live for days in the chamber after treatment with the tagged additive and all breath, urine, and feces are collected. By drawing the breath continually through the very sensitive ionization tube, a complete record of utilization is recorded on the chart.

Many processed foods are dry mixes and large-scale production of these requires a considerable knowledge of mixing and blending characteristics in order to insure uniformity of the end product. Such mixing studies are facilitated by using a radioactive tag on one of the components. Similarly, coffee beans may be tagged prior to blending with other beans and roasting. By tagging all of one type of bean, blending, roasting, and then again separating out the tagged beans, it was possible to evaluate the individual contributions to flavor. It is difficult to imagine how this could have been done other than with radioisotopes.

A further example is the case of determining how much of a processing chemical actually ends up in a finished product where the residual amounts are too small to determine by ordinary chemical methods. One such process involved the use of a foam-reducing agent in the production of a foodstuff. By making the agent radioactive and running a small-scale bench-top experiment, the product was assayed for activity and the amount of the remaining agent estimated.

Tagged minerals greatly facilitate the determination of the nutritional availability of mineral supplements to animal feeds, by permitting rapid determination of the rate of appearance of the mineral in the bloodstream. In fact, isotopes have become an extremely useful tool in food research.



Automatic metabolic apparatus used for measuring the amounts of radioactive substances excreted by animals fed tagged foodstuffs

Antibiotics for Food Preservation

On November 30, 1955, the Food and Drug Administration officially opened the door to a new method of food preservation thereby adding one more to the rather small select company of not more than a half-dozen methods in previous commercial use. This was in the form of acceptance of the use of aureomycin (chlortetracycline) for the preservation of dressed poultry. This undoubtedly is only the forerunner for a revolution in the handling of fresh fish and meats and possibly other foods.

In 1950, when the use of the antibiotic, subtilin, combined with mild heat for the preservation of canned vegetables was first proposed by Andersen and Michener (5), it started a considerable investigation and a storm of controversy, climaxed by a note of warning from the National Canners Association (6). Later, it became well established that the use of subtilin did not destroy or permanently inhibit the growth of microorganisms in canned foods. This controversy did not kill off research; fortunately, research thrives on controversy. A very complete review of the literature on the use of antibiotics in food preservation was recently published by Campbell and O'Brien (7). This article reviews 75 papers indicating the extensive research interest in this subject.

As early as 1945 and 1946, Curran and Evans (8, 9, 10) recognized the possibilities of using antibiotics for food preservation. They studied the use of penicillin and streptomycin in connection with the preservation of fresh milk. Neither of these was regarded as a reliable agent for preserving milk, although the greater efficiency of these antibiotics in conjunction with mild heat was noted.

The Food and Drug Administration took the position in 1949 that the use of antibiotics in food constituted a public-health hazard stating that "the consumption of food so treated may cause sensitization of the consumer to such antibiotics and may result in the emergence of strains of pathogenic microorganisms resistant to these drugs." It was further stated that "the direct or indirect addition of such drugs to such foods may be deemed as adulteration within the meaning of..... the Act."

The use of antibiotics in the field of canning has been studied intensively. In 1951 Cameron and Bohrer (11) stated the requirements for establishing proof of the efficiency of an antibiotic as a preservative in canned foods. This was related to the work of Andersen and Michener of the Western Utilization Research Branch Laboratory on the proposed use of subtilin as a preservative in canned foods.

Later, H. L. A. Tarr (12) and his associates studied the effects of several antibiotics in the preservation of fish and beef, including penicillin, terramycin, streptomycin, Aureomycin, and chloromycetin. They found that Aureomycin markedly inhibited spoilage when incorporated in minced fish and in steaks immersed in solutions of the antibiotic.

At the present time there appears to be no antibiotic which shows promise as a substitute for heat processing of canned foods where permanent inhibition of bacterial growth is mandatory. Furthermore, the presence of antibiotics in food intended for human consumption, except where they would be destroyed before the food is eaten, is viewed with considerable alarm by the Food and Drug Administration.

In 1954 Kohler, Miller, and Broquist (13) reported studies on the control of poultry spoilage, which included commercial tests in a poultry-processing plant. When poultry was immersed for 2 hr in a cooling tank containing 10 ppm of aureomycin, whole, eviscerated, and cut-up chickens were still in satisfactory condition after 3 weeks' commercial storage (3 C). Furthermore, even when 100 times higher concentrations were used, the residual aureomycin left in the meat was readily destroyed by cooking, thus proving safety for the consumer.

It was on the basis of such evidence of safety and advantage that the Food and Drug Administration in November, 1955, established a maximum tolerance of 7 ppm of the antibiotic in the dressed poultry; however, since it is heat-liable, it is completely destroyed in cook-

ing, and therefore of no real concern to the consumer. The future extension of this type of processing to improving the quality of other meats, fresh fish, and poultry seems obvious and in the consumer's interest, since tests have shown that the use of aureomycin halts or slows the growth of spoilage bacteria. It must be noted, however, that antibiotics do not prevent; they merely delay spoilage, and may be considered, therefore, as an added safety factor in the handling of fresh foods.

The Problem of Food Additives

Food additives have been receiving increased attention during the past few years and rightly so. The demand by the consumer for food products with built-in stability, longer keeping quality, more uniform texture and flavor, and greater convenience for preparation, have made their use almost mandatory. These food additives may be divided into three groups; those added intentionally, those which remain as processing residuals, and residuals from pesticide treatment. Intentional additives may include aromatic chemicals as flavor ingredients, FDA certified colors, antioxidants to prevent or delay rancidity of fats, emulsifiers to facilitate the mixing of fats and water and to prolong this association, gums as thickening agents, preservatives to inhibit microorganisms, artificial sweeteners in low-calorie products, and others. Also, vitamins and minerals in enriched foods can be included in this category. Representatives of the class of nonintentional processing residuals may include small amounts of acids and salts, solvents, plasticizers in packaging films, and others.

The ethical food producer is conscious of his responsibility to the consumer of his product and is careful to insure that every ingredient included in his food is safe for consumption. The proof of safety for a food additive is indeed a difficult and costly procedure, but one that must be carried through. Food and Drug Administration personnel have published (14, 15) suggested procedures for the appraisal of the toxicity of food additives.

The procedures for testing the safety of a food additive are somewhat different from those required for drug testing. A drug may have undesirable side effects, but these are balanced or outweighed by the therapeutic effect. The drug is generally administered over a rather short period of time and the dose is carefully balanced against the acute toxicity of the drug. On the other hand, food additives are generally consumed in small amounts over a very long period, lifetime, and the consumption level (dosage) must be correlated with chronic effects rather than with acute effects.

In addition to the toxicity, one must consider the amount proposed for addition to foods, the variety and types of food to which it is proposed to be added, and the amounts of foods which might be eaten containing the additive. This is the exposure. The effect of the ingredient on the food chemically must be taken into account. For instance, the destruction of an essential nutrient or the formation of a toxic component may occur after addition and this would not be uncovered by a study of the toxicity of the ingredient itself. If the exposure appears to involve even a fairly remote hazard to the consumer, that particular additive is avoided. This may materially hamper the food technologist in his effort to give the consumer more convenience, or palatability, or keeping quality, but it doesn't stop his effort. There is always some other way to achieve a desired result.

The vigorous and aggressive food processer finds himself deeply involved in assessing the suitability of food ingredients and often this testing involves ingredients which have been in common use for years for occasionally even one of these proves to be unsuitable for food use. A recent example is coumarin which is available either as an extract of Tonka bean or as a pure chemical. This was a flavor ingredient which for years was widely used along with vanilla and, in some instances, at a rather high level. Nevertheless, once shown to be hazardous, it was withdrawn from use. It is to be expected that other ingredients with long use also may turn out to be unsuitable for food use. Obviously, common usage is not an infallible guide to safety.

The responsibility for the protection of the public against the inclusion of harmful ingredients in foods rests legally with the Food and Drug Administration under the directives of the Federal Food, Drug, and Cosmetic Act of 1938 as amended. However, in a real sense the ethical food manufacturer has the primary responsibility and, in fact, considering his long-range business objectives, he may be said to have a selfish interest in producing only such food products as are completely free from any hazard to his customers. At the same time he must be constantly looking for new ways of satisfying ever-changing consumer demands.

The Food Protection Committee of the Food and Nutrition Board, National Research Council, has issued a number of statements in pamphlet form (16–19) which adequately discuss the philosophy and present-day thinking on food additives.

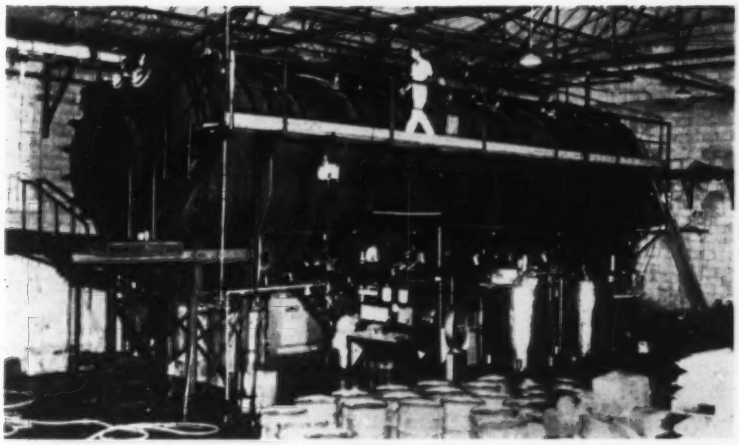
Commercial Trend to Convenience Products

The do-it-yourself trend in home activities includes the kitchen. Accordingly, the outstanding trend in the food field is the trend toward convenience foods, particularly the "heat-and-serve" foods and the "instant" products which require only the addition of milk or water and a little stirring. Since the last world war, we have become accustomed to brown-and-serve bakery rolls, ready-to-bake frozen meat pies, and other frozen prepared dishes that require little or no kitchen preparation, no garbage-disposal problem, and few, if any, kitchen pans to clean. Examples of other commercially established convenience products are minute potatoes and quick-cooking rice.

Instant coffee is mentioned elsewhere in this paper; it eliminates the brewing and the messy coffee-grounds disposal, and, of course, saves both time and product since it is so convenient to prepare one or two cups as needed, with no waste to throw away. Certainly, convenience and quality are both factors in its phenomenal growth.

The prepared-mix business has grown tremendously since the war. The housewife who bakes her own cake, starting with her own long list of ingredients, is rapidly disappearing. The improved cake mixes, and the new frosting mixes, have convinced her that on the average she stands a better chance of pleasing her family with the commercial mixes which require so little skill to prepare, and they do save both time and work.

The commercial acceptance of these mixes would not have been possible without some of the new emulsifying and stabilizing additives developed by the chemical industry; they permit the simplification of the mixing operation and improve the texture. It is like the me-



Continuous vacuum dehydrator used for drying citrus juices resulting in a crystal product readily reconstituted in cold water. (Photo courtesy *Food Engineering.*)

chanical development of the automobile, which was dependent on the separate development and availability of suitable gasoline.

The flavor, and other palatability factors, of the cake mixes would not be satisfactory without the improved egg products discussed in another paragraph, nor without the recent improvements in stabilizing flavor ingredients by such means as spray drying the volatile flavor oils in a water-soluble gum base, thereby preventing its loss from the package but releasing it when the batter is prepared. Suitable antioxidants are needed to protect the fat which forms an important part of most cake mixes.

The current trend is for greater variety in mixes and simplification of directions, elimination of all excess motions, shortening of preparation time, fewer dishes to clean, and so on. The new instant desserts are typical of the trend; they require no skill and practically no time for preparation.

In all of these developments, food technology has played a major role. It is not possible to go into all of these. The rapid setting of instant desserts can be achieved in more than one way and is covered by several patents (20). The selection of the correct emulsifier for each cake mix has been the subject of research by all the companies involved, and this field is also covered by a number of patents (21). The proper balancing of the many ingredients in a cake mix, to achieve just the right degree of foolproofness and the desired texture and keeping quality, has been the subject of intense research. Each new improvement will have to be obtained the same way, and each new ingredient developed by allied industries will require intensive experimentation to determine whether it adds something to fulfill the consumer's demand for variety, quality, and convenience.

Even the early frozen foods provided convenience as compared to the fresh product as is readily recognized by comparing a package of green peas with its equivalent of peas in the pods; however, more and more precooked products which need no home preparation except warming before serving are becoming available. The tremendous commercial success of fish sticks is but one example; others are different types of meat pies, fried chicken, and a wide selection of other complete meal items often referred to as TV dinners.

There appears to be a relationship to proper timing in the marketing of convenience items. The ready-to-heat-and-serve, precooked frozen dinner was one of the early ideas introduced when the frozen-food industry was still young. However, public acceptance was slow in coming, and several attempts to commercialize the idea met with discouragement. The past few years, however, have seen a rapidly growing consumer interest in precooked meals and, consequently, increasing variety is now available in the market.

All of these convenience food products pose problems to the manufacturer commensurate with the advantages to the consumer. Every additional processing step introduces another point where careful controls are called for. Although precooked, these are all perishable foods, not subjected to sterilizing temperatures at any point in the processing; hence sanitation control is of major importance to the manufacturer as well as the consumer.

The demand for convenience will continue, and even on the farm, the completely home-cooked meal may soon become as much of a novelty as the plow horse is now.

Miscellaneous Developments in Processing

Frozen Orange-Juice Concentrate. Frozen orange-juice concentrate is now the leading frozen-food product in the United States in sales dollar volume. In fact, it is so much a part of our normal daily life that it is difficult to realize that this commercial product had just been born only 10 years ago.

The tremendous consumer acceptance of this product, and its many younger relatives in the fruit-juice field, is an outstanding example of what modern engineering can contribute to the advancement of food-processing and distribution. Aside from obvious dependence on established frozen-food technology, this development came about through advances in the design of high-vacuum low-temperature evaporators which made possible the economical concentration of orange juice without subjecting it to flavor-destroying temperatures. These engineering advances made possible the production of a product that tastes fresh, and has the vitamin potency of fresh juice, and which can be distributed at a price competitive with fresh fruit. The added con-

venience—the elimination of squeezing and straining of fresh fruit at home—is the plus factor which the consumer receives at no increased cost.

For a summary of the early developments in this field, the reader is referred to the July, 1949, issue of *Food Industries*, which contains process flow sheets and discusses the operations at the Florida Citrus Canners Cooperative at Lake Wales, Fla.

The more recent developments within this industry have been summarized by W. Price-Davies (22) and by E. J. Kelly and H. W. Schwarz (23) and need not be discussed here. Major problems overcome by the industry have related to flavor retention, oil content, microbiology, and pectin-esterase content.

The latter particularly posed a problem, in that the natural and desirable turbidity of the orange juice depends on the pulp being properly dispersed in the reconstituted juice. This, in turn, is dependent on the natural pectin content. If the frozen juice concentrate, during distribution or after reaching the consumer, is left for some period at temperatures above 15 F, the pectin esterase acting on the pectin causes gel formation, which, in turn, results in poor dispersion and sedimentation of the pulp in the reconstituted juice. The net result is an unattractive unpalatable product. The pectin esterase is readily destroyed at pasteurizing temperatures; unfortunately, such temperatures are also very destructive to the fresh orange-juice flavor. Several methods have been devised to overcome this dilemma, all of which depend on the principle of reducing the enzyme activity by heat-treatment without subjecting the juice to enough heat to damage materially the fresh flavor (24, 25).

Whether this revolution of the past 10 years will hold its own, or be replaced by other more recent developments, it is too early to say at this time. Two possible contenders for the consumer market in the future would be a completely dehydrated product not requiring refrigeration, or possibly a synthetic substitute of equal, or greater, nutritive and palatability appeal.

Dehydrated Fruit Juices (Puff Drying). An interesting new development, which has as yet not made any real impact on the commercial market, is the production of completely dehydrated orange-juice crystals. S. I. Strashun and W. F. Talburt (26) of the Western Regional Research Laboratory, U. S. Department of Agriculture at Albany, Calif., accomplish this by pouring high-density orange-juice concentrate, such as commercially produced for frozen-juice concentrate, in a thin film on stainless-steel trays, subjecting it to a vacuum about 4 mm Hg with a product temperature cycle which does not exceed 140 F. Pressure and temperature are maintained so that the concentrate puffs up into an expanded honey-combed structure which is 15 or 20 times the original volume. The puffed substance is then ground to a fine powder which is readily reconstituted in cold water.

The loss of orange flavor due to volatilization may be compensated for by adding back natural orange oil to the powder. The same process has been applied to other fruit juices such as lemon, tomato, pineapple, apple, and grape. A continuous-belt process for producing orange-juice crystals has been operating in Florida for about 2 years.

Even with a dry product, retention of quality is a major problem. The original quality must be retained from the time the product is made until it reaches the consumer's table. Several safeguards are needed. These include packing with an in-package desiccator in a vacuum tin. Calcined lime has been used as an in-package desiccant. Storage results with the desiccant in place show that the moisture drops from 3 to 1 per cent in one month at 70 F (26). At this level of moisture, the product is claimed to be acceptable after a 6-month storage at 100 F (27).

Table 2 Growth of Acceptance of Soluble Coffee

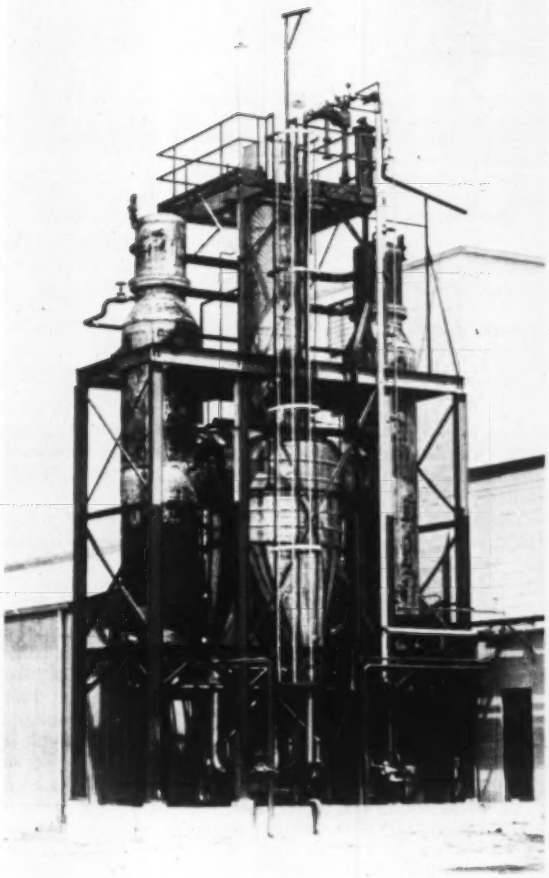
	Total U. S. coffee consumption (1000 lb)	Percentage[a] of total coffee consumption sold as soluble coffee in the U. S.
1946	1,383,000	6.3
1947	1,380,000	7.5
1948	1,414,000	8.3
1949	1,519,000	8.4
1950	1,415,000	11.0
1951	1,428,000	13.7
1952	1,540,000	17.4
1953	1,671,000	21.9
1954	1,703,000	30.4
1955	1,843,000	34.0
1956		36.0 (est.)

[a] This percentage is based upon accepted market research formula of 2 oz of soluble coffee being equivalent to 1 lb of ground coffee.

Dehydrofreezing. Another interesting combination of dehydration and frozen-food processing is dehydrofreezing now in limited commercial use. This process, developed at the Western Regional Research Laboratory by R. R. Legault and W. F. Talburt (28), recognizes that ordinary freezing sometimes destroys cellular structure, while cells that are partially dehydrated are not so easily destroyed by subsequent freezing. It is claimed that dehydrofrozen foods, such as fruits and vegetables, combine the economics of dehydration with the freshness retention of frozen foods.

Miscellaneous Developments in Dehydration. Dehydration of food utilizes all available drying methods from sun drying to freeze drying, from tray drying to continuous-belt drying, from vacuum drying to spray drying. Of course there have been advances in these fields, but we shall not attempt to cover these except to the extent that they are incidental to major food-product or process developments. Among the new dehydrated products introduced commercially since the last world war are several which owe their success to the increasing consumer demand for convenience. Among such products we should mention soluble coffee, which has grown from reluctant acceptance by the military during the last war, to a quality acceptable to a very large proportion of the coffee-drinking population. The remarkable growth of this product during the past ten years is shown in Table 2. At present, more than one third of the coffee consumed is soluble coffee and that proportion is still increasing.

An interesting development which has been indirectly stimulated by the shift to convenience products is that of dehydrated eggs. It has been said that nature did not intend the shell of an egg as a shipping container, nor for more than temporary storage. Much research has been directed toward the problem of producing dehydrated eggs which will keep in storage for a long period without loss of natural flavor and without the development of off-odors or flavor. A major problem which confronted the food technologist was the browning which occurred during and after the drying of fresh egg whites. The Chinese long ago avoided this by fermenting out the sugars which are the cause of this



Mojonnier Lo-Temp Evaporator installation in the plant of J. W. M. Horsey Company at Plant City, Fla., for the concentration of citrus juices

reaction. However, in so doing, they also developed a rather unappetizing smelly product. One obvious answer was a carefully controlled fermentation process (29, 30). Another is a recently patented process (31, 32) which utilizes an enzyme for the removal of the glucose.

Research on dehydrated eggs was greatly stimulated by Army support during the last war; since then the need for high-quality egg products in the rapidly growing cake-mix business has forced the continuation of research leading to further quality improvement. Recent developments were well summarized following the symposium held at the University of Chicago in February, 1953, under the auspices of the Quartermaster Corps (33).

Ultrasonics in Food Processing. High-frequency inaudible sound waves have been experimentally utilized to produce a number of chemical and physical changes in food products. These may well develop into a number of practical applications; however, large-scale utilization may be some time in the future. Promising results have been obtained in the fields of sterilization, defoaming, homogenizing, extraction, and dehydration.

Relatively speaking, however, only the surface possibilities of ultrasonic irradiation have been investigated. It provides a most interesting tool for the food technologist to use, and a number of practical commercial applications may well be anticipated, either in one of the fields mentioned or some other processing area.

Dietetic and Specialty Foods

There is always a new crop of novelty food products in the market place. Some of these may masquerade under a special health banner, others are marketed simply as novelties, be it canned rattlesnake, fried worms, or some other new cocktail snack. Some of these are indeed interesting, but need not be considered here.

There is, however, a very legitimate trend toward filling the dietary needs of various consumer groups who must subsist on a restricted diet, such as the very young, the very old, the obese, and the diabetic.

Everyone is acquainted with the convenience supplied by the extensive array of baby foods found in every grocery store. We can anticipate that there will be available soon a selection of "senior" foods which will satisfy the dietary needs of the oldster and also, what may be fully as important, reduce the required kitchen work to a minimum. "Geriatrics" is a word that will see increasing use in the food field (34).

Over the years a few artificially sweetened, sugar-free products have been marketed for use by diabetics. Recently, however, the recognition that obesity is a major factor in many diseases that cause death after age 45 (35) has spurred the demand for a greater variety of low-calorie foods. Taste tests at the University of Massachusetts and elsewhere show that canned fruits, wherein the usual sucrose syrup has been replaced by saccharin or Sucaryl syrups of equivalent sweetness, are as acceptable as the regular pack, and very much preferred to water-packed fruit (36). No off-flavors were noted. However, federal regulations do not permit the normal marketing of food products which look like and taste like a standardized product if they in fact differ in composition from the standard. In that sense saccharin or Sucaryl is not equivalent to sucrose. But even the law is responsive to public opinion and the public, as well as the medical profession, is becoming increasingly calorie-conscious. Therefore a significant development is the approval by the Food and Drug Administration of limited experimental marketing of artificially sweetened, low-calorie, canned-fruit products (37, 38). It is to be anticipated that this is in the nature of a pilot run which will lead to revised standards and a more general marketing of low-calorie products to meet a growing consumer demand. It could be argued that all that is necessary is to leave the sugar out and let the consumer add her own artificial sweetener. That, however, would add an inconvenience, contrary to the general trend of the times.

The requirements for low-sugar, low-calorie, low-salt, or spice-free diets make legitimate demands on the food technologist and the food manufacturer. It can be anticipated that whenever any new dietary need becomes sufficiently recognized there will be new foods to fill that need.

Packaging Developments

Progress in the Field of Canning. Technical progress in the field of canning is partially related to processing and partially to the container; however, the can manufac-

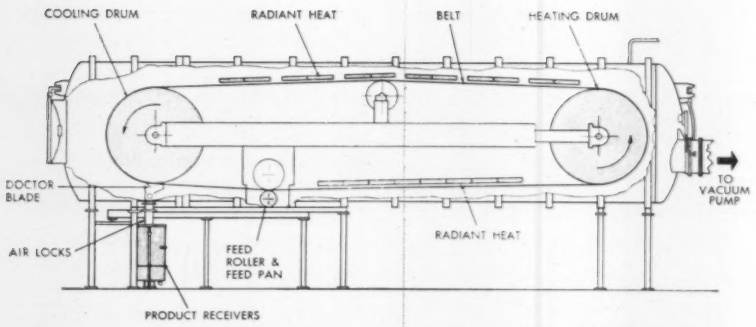


Diagram showing Chain Belt Company's vacuum dehydrator used in processing orange and other fruit-juice crystals, coffee crystals, milk products, pharmaceuticals, biologicals, and many others

turers have been major factors in both, and we may therefore conveniently consider the two together.

Over the years, canned foods have continued to improve in over-all quality—in many cases, actually surpassing in vitamin retention the fresh products available in the average corner grocery store. The case for the nutritional quality of canned foods is well documented in a series of publications by the National Canners Association Laboratories and the Can Manufacturers Institute (39). The quantity of foods distributed in cans also continues to increase year after year, and in 1953 reached the almost unbelievable figure of over 35 billion cans. This is impressive when compared with an estimated 2 billion cans produced in 1900. There is at present little likelihood that any other means of preservation can seriously challenge the convenience, economy, and safety of the hermetically sealed can.

Much research, however, goes on within the canning field. On the processing side, there recently has been added a commercially perfected process (the Martin Process) (40) which permits the aseptic filling of cans with flash heat-sterilized products, thereby avoiding excessive heat-treatment of products that may be sensitive to the sterilizing temperatures normally associated with canning retorts. This results in finer-flavored foods.

The actual container has been the object of years of research. Since the beginning of the last world war, the average tin coating has been reduced to half without lowering the quality of protection. This in 1952 amounted to a saving of 33,729 long tons of tin (41) over what would have been required on the prewar basis. This development was, of course, stimulated by wartime shortages of tin; however, research continues to look for completely satisfactory alternatives to the tin which might well once again be in short supply.

In May, 1955, following an atomic-explosion test in Nevada, canned foods were found intact at distances of 3750 ft or more from Ground Zero, indicating that canned foods would survive an atomic explosion. Examination of these canned rations showed that the foods were not physically damaged except for several perforations caused by glass fragments. Furthermore, the intact canned foods were proved to be safe for consumption. Other canned foods located nearer Ground Zero are currently undergoing long-range tests to discover whether the foods were changed nutritionally or rendered toxic by the high radiation.

An excellent review (43) of 12 years of technical progress in the United States Canning Industry was presented at the Second International Congress on Canned Foods in Paris, France, in October, 1951.

Other Packaging Developments. There was a time when the package was merely a container for carrying the product from the place of origin to the point of use. The old-time cracker barrel and the ordinary paper bag are examples of that type of package. In the food field, that has long since been changed. In many cases, the food package is an important part of the product sold; it is designed not only to give the correct degree of protection to the product, but also to help sell the product to the consumer. The latest trend is toward a package which gives additional convenience to the user, typical examples being the aluminum-foil pans which serve the dual role of protective package and disposable baking pans for heat-and-serve products, such as frozen chicken pies, brown-and-serve rolls, or frozen steak. These packages are convenient and they avoid the need for cleaning baking dishes.

The protection needed by different products varies; it is as easy to overprotect some products as to underprotect. For example, toasted-cereal products need protection against moisture in order to retain crispness, but the package must also permit some breathing to avoid rancidity development. Some products are very hygroscopic, other products tend to dry out, some must be protected against the oxygen in the air, others require a package that will prevent fat leakage, or the transmission of odors. Siftproofness and insectproofness at times become very important.

The large number of new packaging materials, particularly the newer plastic films, give the packaging expert an opportunity to fit the package to the needs of the product and the consumer.

A few of the new packaging films and their specific merits are listed in Table 3.

Despite the array of packaging films available to the food industry, many by themselves do not offer all the desirable characteristics to meet the requirements of a wide variety of foods. Of course, by combining films and by using laminations and coatings, specific requirements can be met, but these operations increase the cost of packaging. It is hoped that the chemical industry will one day announce the discovery of a single film having the following desirable properties: high resistance to puncture and tear; proper stiffness to feed well

Table 3 New Packaging Films

Name	Type of Packaging: Material	Characteristics
Saran	Flexible thermoplastic film; copolymer of vinylidene and vinyl chloride.	Transparent. One of the best plastic barriers to the transmission of moisture, gases, and odors. Unaffected by most chemicals, oils, and greases. May be heat-sealed to produce vacuum packages. Tolerates moderate retort temperatures. At present used primarily for cheeses, luncheon meats, bologna, sausage meats.
Polyethylene	Flexible thermoplastic film.	Transparency varies Tough film. Moderately resistant to passage of moisture; relatively permeable to gases and odors. Good resistance to most chemicals; variable permeability to different greases and oils. Readily heat-sealed forming strong welded bond. Limiting temperature of standard films about 200 F. (Low pressure linear-polyethylene, now in early stages of development resists temperatures up to 250 F.) Excellent heat-sealing properties and strength of polyethylene make it ideal for liquid packs (mustard, soy sauce, maple syrups, ketchup, etc.). Bags for fresh produce. Used as adjunct to aluminum foil, films, and other barrier materials to produce strong tightly sealed packages. Molded rigid poly used for squeeze bottles.
Cellophane	Regenerated cellulose flexible film (usually coated).	Traditional transparent packaging medium. New coating materials for cellophane incorporating Saran result in barrier properties and oil resistance superior to that obtainable heretofore.
Pliofilm	Flexible thermoplastic film; rubber hydrochloride.	Fairly transparent. Tough film. Good barrier to odors and oxygen. Good chemical, grease and oil resistance. Stretchable for stretch wrapping of fresh produce items. Useful in food products which are oily and greasy. Also useful as coffee bags.
Vinyls	Flexible plastic synthetic-resin films of varying composition.	Transparency varies. Tough film. Moderate moisture barrier. Good resistance to greases and oils. Used where toughness is important as in margarine squeeze bags, for oily and greasy foods. In molded form, used for disposable jelly containers, etc.
Mylar	Flexible polyester film.	Transparent. Extremely tough film. Heat sealable. High-temperature stability. Currently used on a fairly limited scale such as in reheatable envelopes for shrimp, etc. Very promising potential for producing strong durable packages when combined with aluminum foil and other barrier materials.

through high-speed equipment; good printing surface; transparency in the visible range combined with opacity in the ultraviolet region; impermeability to water vapor, oxygen, fats, and oils, and all odors; a wide melting range to permit formation of strong hermetic heat seals by simple heating bars or rolls; freedom from toxic or odorous components, and a cost comparable with that of waxed paper!

No doubt the already extensive use of plastics in food packaging will greatly increase over the next 5 to 10 years, particularly where such a package will give the consumer benefits not inherent in current types of packages. It is conceivable that many products now packed in rigid containers, either tin or glass, may be marketed in readily disposable flexible containers. It is likely that the European habit of putting food products in squeeze tubes like our toothpaste also may be introduced gradually in this country. Products like mayonnaise, mustard, ketchup, and many others are more conveniently squeezed out of a tube or polyethylene squeeze bottle than dispensed from a glass bottle or jar. This may be the answer to the sometimes frustrating battle with the ketchup bottle.

Glass containers are often used to replace tin cans in food packs where visibility of the contents develops consumer appeal. The glass industry has gone far in overcoming two serious objections raised by food packers —low rate of heat transfer and breakage by mechanical or thermal shock. This has been done by a special annealing process which permits reduction in the weight of glass used per jar without loss of strength. This development has also helped narrow the difference in freight costs between glass and tin packs. Closures for glass containers have had an interesting history. The time-honored screw cap has been replaced to a large degree by the snap-on, side-sealing gasketed type. This trend has been paralleled by modern kitchen mechanics who have provided the housewife with efficient pry-off tools which are preferred to the kitchen equivalent of a pipe wrench to open the screw-type closure.

Achievements and Future Course

A couple of years ago Paul S. Willis (44), president of the Grocery Manufacturers of America, stated:

"In the past 15 years there has been a revolutionary change in the character of the grocery basket—a change greater than that between the 1939 and the 1954 automobile. There has been a striking expansion in the consumption of processed convenience foods with their many consumer dividends—menu variety, high nutritive value, tastiness, and above all, the ease and speed of preparation with a tremendous saving of time and work in the kitchen. There has been a great transfer of the

work of food preparation from the homemaker's kitchen to the food-processor's plant."

This revolution in the grocery basket and the kitchen could not have been possible without the concurrent revolution in food processing, a revolution which incidentally is picking up speed rather than slowing down. The end results, as summarized by Mr. Willis, are apparent to everyone who goes shopping at one of the supermarkets; however, to get to this stage required the application not only of engineering, but also the latest developments in basic scientific disciplines. Moreover, it required the utilization of many new ingredients and products made available through the application of science in related fields. The utilization of low-temperature evaporation techniques and cold sterilization by irradiation; the use of antibiotics to retain freshness of perishable meats and fish, and the addition of the new emulsifiers in prepared mixes, and so on, are all examples of science and engineering applied to an old art, for the creation of the new and the improvement of the old.

In doing this, the food technologist has been, and is, guided all along the way by the scientific sampling of consumer opinions and consumer wants.

In the future we can anticipate that the demand for convenience of storing, convenience of serving, and convenience of disposal will continue to be major influences directing new product development. Whether dehydration, irradiation, freezing, or canning will win out in any given situation will largely depend on which process offers the consumer the greatest freedom from time-consuming activities in connection with the use of the product within competitive areas of quality and costs.

We do not believe that any one of the methods of preservation will replace the others in all areas, or even in any major area. The frozen-foods field is growing, but so is canning. Irradiation will likewise find its place of application without necessarily replacing the general use of any of the older processing methods.

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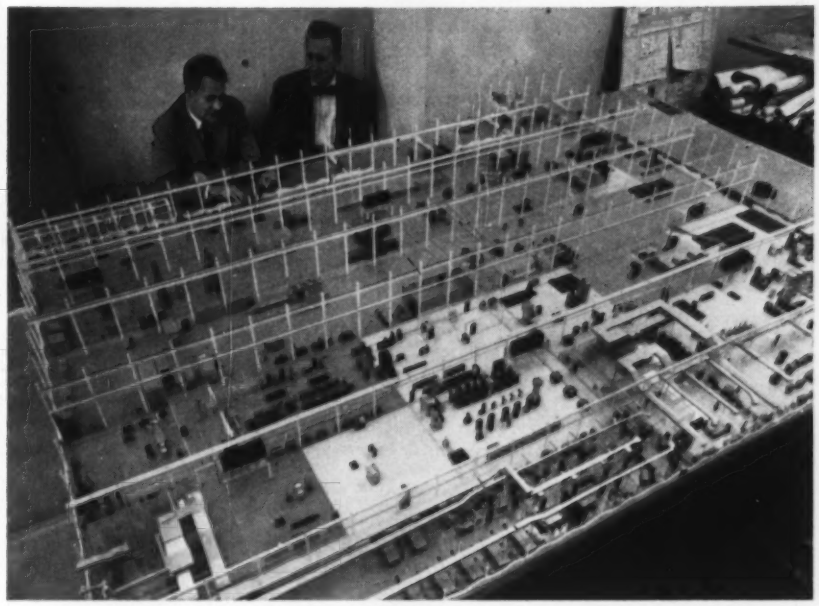

The use of 3-D models in planning industrial plants makes it readily possible to spot unsafe arrangements. Even the most experienced engineers find it difficult to visualize all conditions that may occur in a plant when it is necessary to rely solely on drawings or templates.

Planning for Safety

Important plant-layout safety principles and features in industrial plants, and the plant-layout engineer's opportunity to provide for future safety of plant personnel

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A REALLY safe plant must be well-planned. Catchy slogans may alert employees and make them safety-conscious. Safety education almost always results in a decrease in accidents. Safety-first contests also have short-term benefits. But for the long pull, a good safety record reflects good factory planning.

In the case of industrial safety, there is no better foundation for accident prevention than preplanning it into the plant layout. If the plant is properly planned and laid out, a minimum number of accidents will occur, other things being equal.

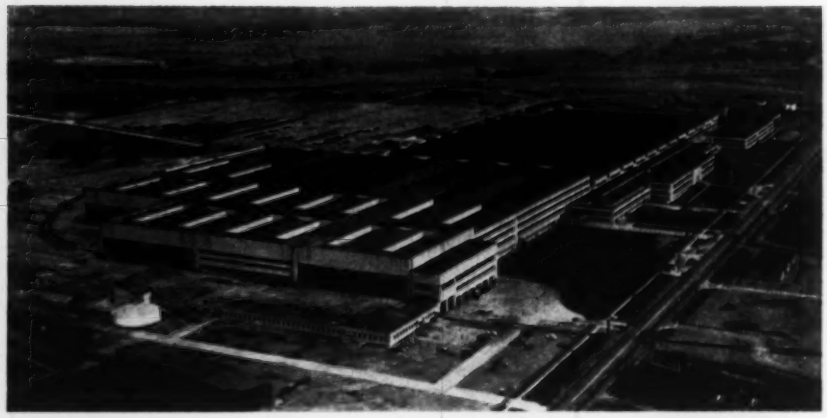
Most plant executives now appreciate the economic value of a good plant-safety record. At one time, not too many years ago, spending money for strictly safety measures was considered a luxury. Thanks to modern statistics, that thinking has changed. Today it is no longer necessary for planning engineers to temper their layouts to avoid the luxury of safety measures. Accidents cost too much to allow safety to be treated lightly in plant-layout design.

In planning the layout, there are numerous elements which must be considered from the standpoint of safety. This paper is devoted to a discussion of the following: the plant site; entrance and exits; aisles, stairs, elevators, ramps, floors, and obstructions; equipment arrangement and guarding; painting and lighting; fire and explosion prevention; first-aid facilities; flow of materials and good housekeeping; and materials handling and storage.

Contributed by the Safety Division and presented at the Semi-Annual Meeting, Cleveland, Ohio, June 17–21, 1956, of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Condensed from ASME Paper No. 56—SA-30.

The Plant Site

Plant location and site have an important bearing on safety. Employees must travel to and from work, and plant location may subject them to travel hazards.



While this plant is located on a four-lane main highway, the entrances and parking lots are so located as to provide a maximum of protection to the personnel. Shop employees park at the rear of the plant and enter through an underground tunnel.

Owing to the usually heavy influx of traffic at shift-change hours, the tendency to rush out of the plant or to beat the whistle getting in, is a factor affecting safety. If the plant is on a busy highway or city street, proper plant approaches should be provided.

If a plant is situated on a terrace requiring the use of stairs or ramps, these may be hazardous during inclement weather. One-way traffic lanes should be considered in the layout of the grounds. Proper shelters for employees using public conveyances are another consideration, as are proper and adequate parking facilities. These are a few of the considerations the plant engineer should give to safety in the plant site.

Entrance and Exits

The mass-production potentials of most modern plants require that materials and personnel be able to move in and out of the plant quickly, safely, and economically. Some safety features to think about when planning a new layout or when changing an old one are:

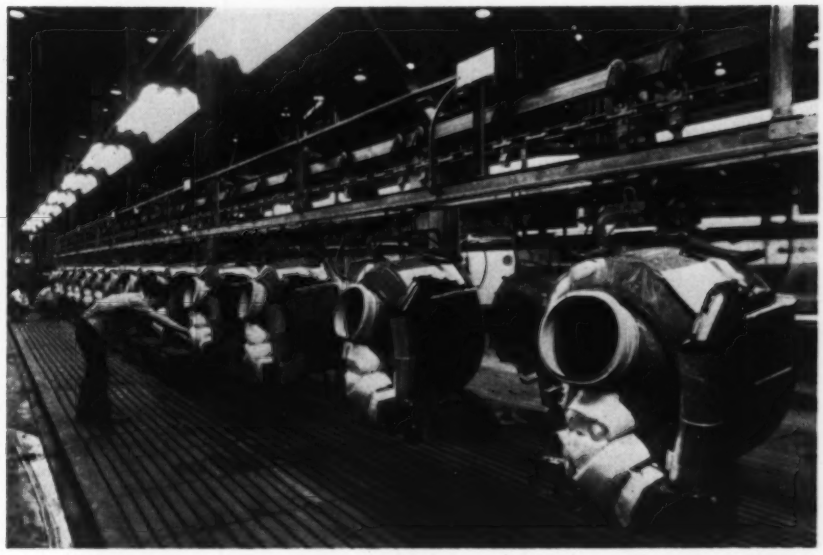
(*a*) Wherever possible rail, highway-truck, industrial-truck, and pedestrian traffic should be separated. Where this cannot be done, the movement should be planned in such a manner as to avoid possibilities of collision.

(*b*) Sharp turns, grades, blind spots, intersections, crossovers, congested points, and similar "built-in" hazard potentials should be avoided.

(*c*) It is better and safer to eliminate by good planning and design any potentially unsafe work conditions than to alleviate the hazard later on by some "protective means." To this end, the use of three-dimensional models is a worth-while aid.

(*d*) Where the volume of traffic is heavy, receiving and shipping departments should be designed with depressed docks or elevating platforms to permit loading and unloading of carriers by mechanical means at floor level. Proper clearances between the sides of the vehicles and obstructions should be observed. Statutory codes in some instances are too liberal for good practice.

A properly designed plant entrance can be "safe" as well as eye-appealing. At this plant employees and visitors can enter or leave, free of concern over traffic jams.



Note the special floor in this assembly area, also special lighting. When working conditions can be made as good as this, accident potentials are greatly reduced.

Aisles, Stairs, Elevators, Ramps, Floors, and Obstructions

Aisles. Factory aisles, particularly the main traffic aisles, should be of generous width, as straight as possible, and completely free of obstructions. Where possible, corners should be cut off on a diagonal and visibility should not be obscured. If vehicles must pass in the aisle, the latter should be at least twice the width of the widest part of the vehicle or load, plus another 3 ft if the aisle is also used by pedestrians.

If the traffic is not heavy, the aisle can be of a width equal to the maximum width of the vehicle or load plus 2 ft, provided passing zones are established at intervals of from 150 to 200 ft.

One-way traffic aisles are receiving increased attention in industry and should be encouraged. Look at what they did to help traffic conditions in our cities.

The aisle should be marked by lines of suitable width and color, safety orange preferred. Permanent markers such as metal disks are also suitable. The floor surface should be free of any deformations and kept clean at all times.

The surface material should be suitable to the needs of the traffic loads transported. The aisles should be well-lighted and, if not lighted at night by general lighting, should be illuminated by night lights for the benefit of service employees or off-shift workers. If the aisles are designed as emergency passways, they should be marked by regulation exit markers.

Stairs. Stairs are always a potential hazard. Wherever possible it is best to eliminate them. When this is not feasible, they should be designed for a maximum of safety. Some features to keep in mind are adequate width, handrails on each side, and one in the center if the stairs are wide. Risers should be of nominal dimension and treads sufficiently wide. A nonslip surface, particularly at the nose, is desirable. Landings should be spaced at generous intervals. If located outdoors, the stairs should be designed for quick and easy cleaning during inclement weather. Radiant heat can be considered in the design of concrete steps to keep them clear of snow and ice.

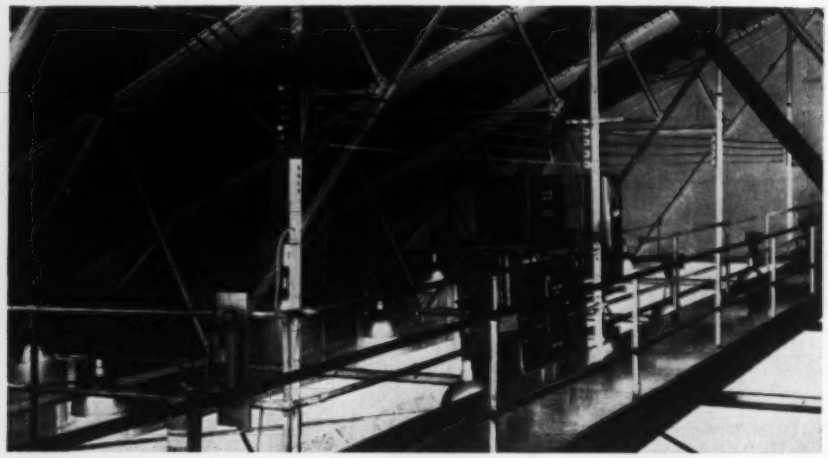
Elevators. Elevators have received much attention in recent years as they are still the mainstay in vertical transportation; but they are fertile areas for accidents if not properly planned for the tasks they are called upon to perform. While most states have strict elevator codes, this does not prevent their misuse.

When planning movements by elevator, it is extremely important that the unit not only have sufficient capacity to carry the gross load but also be structurally designed to accommodate unbalanced or pin-point loads. For example, a 10,000-lb elevator floor might collapse if the 10,000-lb load is distributed over only four small wheels of a truck. The elevator also should be of suitable design and construction to operate smoothly and to level accurately at each loading and discharge point. Care must be exercised to avoid the possibility of load-shifting while the elevator is in operation.

Approaches must be free of obstructions at all times. Doors should be designed so as to require that they be closed while the elevator is in motion or improperly leveled at a landing.

Ramps. Ramps are very useful when slight differences in floor elevations must be negotiated by either pedestrians or vehicles. However, they should not exceed 10 per cent in grade for good practice if used by industrial vehicles. They should have a good hard surface and be kept clean and in good maintenance condition at all times. Handrails at the sides are a good safeguard. Radiant heating on outdoor ramps is a good investment. Curbs should be provided if vehicular traffic is planned.

Floors. Floors, particularly in multistory constructions, should be of adequate structural strength. It costs very little more to increase the allowable load



The maintenance personnel in this plant work high overhead in complete safety and under excellent conditions. Note the protected catwalks, handy fire extinguishers, good lighting, and clean wiring. Equipment which must be serviced is readily accessible.

capacity when designing a new floor. In most plants the occupancy changes many times during the life of the building, so the extra safety factor is a good investment. The floor surface should suit the occupancy and traffic conditions. If this provision is observed, any sound structural material will provide a good floor. The problems arising with most floor surfaces stems from misapplication and abuse.

Floors should be kept free of tripping hazards and be provided with proper drainage if subjected to liquids. Where the floor above serves as the ceiling for the room below, thought should be given to protection from dust, dirt, leakage, spattering, and similar hazards that might result from the occupancy above.

Obstructions. Every factory has its share of obstructions. Pipes, conduits, drains, valves, fire apparatus, heaters, etc., are a necessary part of the plant structure, yet they are often a nuisance or even a hazard. It is very often not too difficult to locate these obstructions in inconspicuous places when the plant is being laid out. Proper shrouding can eliminate much of the eyesore effect and hazard potential. In planning the layout, each space-occupying fixed object should be carefully provided for to make sure that there will be a minimum of interference with persons or materials. Head room is of particular importance.

Equipment Arrangement and Guarding

The arrangement of the equipment within the plant is probably the function which most persons look upon as the plant-layout engineer's predominant field of operation. This is largely true, and it is also the one field in which he can plant or eliminate the most "booby traps."

It is a cardinal principle that the layout engineer should determine the exact requirements of each work station and then make adequate provision for each space-occupying item. This space factor may be fixed, as in the case of an item of equipment, or it may be a variable, such as service access, material clearance, temporary storage, or maintenance provision. It is the failure to provide the proper space factor that germinates accidents.

While the plant-layout engineer cannot be held responsible for the failure of supervisors or operators to utilize space as planned, he can anticipate changing conditions and provide for normal requirements. Since statistics show that about 40 per cent of all industrial accidents are traceable to some source of plant-layout or materials-handling defect, this is a very fertile field for safety development. Proper work-station layout will do much to reduce these accidents. Here are a few points worth remembering:

(*a*) Always allow enough space for efficient operation and safety. But do not allow too much space as this is wasteful and leads to poor housekeeping and ultimate hazards.

(*b*) Be sure to lay out the complete work station instead of only the major item of equipment.

(*c*) In planning the work station, be sure to provide for all necessary handling and storage equipment so that the operator can work safely as well as efficiently.

(*d*) While most machine tools are provided with safety guards by the manufacturer, the special application by the user, the addition of auxiliaries, or the requirements of installation may create the need for additional guarding; be sure to provide for it in the work-station layout.

(*e*) Always have the safety engineer approve the layout before installation is started.

Painting and Lighting

The average operator's eyes work just about as strenuously as his hands in the course of a day's work. The greatest aid to combat eyestrain is correct light and color. The plant "see-ability" problem, of course, requires local study, but the rewards are well worth the efforts. With proper lighting facilities, accidents will be reduced, productivity will rise, and the work force will be generally more content, for eyestrain is a source of many ills and much fatigue. A tired worker is a careless worker. In planning the layout of a plant, therefore, these points should be considered:

(*a*) The level of illumination required at the work station for good see-ability.

(*b*) The quality of light as well as its quantity.
(*c*) The color scheme of the building and equipment surfaces in the area of the work station. It should provide the following effects:

1 Good lighting-reflectivity without brightness or glare.
2 Contrast to make objects easily distinguishable.
3 Pleasantness of surroundings.

Fire and Explosion Prevention

Fire and explosion are potential hazards in nearly every industrial plant. When the plant buildings are first built, the architect or engineer will have provided reasonable safety features, applying to the known occupancy at the time. But plants are seldom static in utilization and as occupancy changes, the plant-layout engineer should see that the necessary changes are made in safety provisions to insure fire and explosion protection. Some of the questions the plant-layout engineer should constantly ask are:

(*a*) Should sprinklers be provided to protect the building or contents or both?
(*b*) Should sprinklers be avoided due to possible greater damage from water rather than fire?
(*c*) Is there sufficient ventilation to prevent the accumulation of an explosive atmosphere?
(*d*) Are hazardous areas properly partitioned off to prevent spread of the holocaust in event of fire or explosion?
(*e*) Are there a sufficient number of fire extinguishers of proper type strategically located throughout the plant?
(*f*) Is the potential danger great enough to warrant a private plant fire department?

First-Aid Facilities

In modern plants of fair size, the first-aid facilities today approach the standard of small hospitals. The scope of the installation will vary with every plant and the potential dangers of the business involved. Most modern plants of small size have at least one good-sized dressing station, ample lavatory facilities, and a cot room Many today have a full-time nurse on duty and contractual arrangements with a local doctor for service. If a full-time nurse is not engaged, several employees who have extensive first-aid training are always available.

From this modest start, plant first-aid departments increase in size, scope, and facilities up to 20-room layouts. Usually such installations accommodate employee-examining rooms, segregated waiting rooms, doctors' and nurses' quarters, and offices, medicine rooms, x-ray rooms, etc.

Flow of Materials and Good Housekeeping

The old adage "a place for everything and everything in its place" is good advice for every industrial-plant management. It is the plant-layout engineer's responsibility to provide the place, and it is the supervisor's job to keep things there. If this team does a good job, accidents and costs will be reduced. In plants where the housekeeping is good and material flows smoothly from operation to operation, the safety record is usually good.

These are some points which the plant-layout engineer should consider in preparing the layout:

(*a*) Provide space at every work station for all things that occupy space whether they be plant equipment or material in process.
(*b*) Know how every piece of material can or will be handled throughout the plant from receiving to shipping. There is a great tendency just to leave it up to the boys in the shop to move it the best way they can.
(*c*) Keep in mind that waste materials must be removed from the plant constantly. Many engineers neglect to provide efficient waste-removal facilities, resulting in a vast accumulation of junk in many plants. Remember that it costs just as much per labor-hour to remove waste material as to move productive salable material.

Materials Handling and Storage

Materials handling accounts for more industrial accidents than any other plant operation. If an improvement in handling had no other incentive, the reduction of accidents which in turn reduces costs would in itself provide the motive.

Basically there are two sources of materials-handling accidents: (1) Lack of proper or adequate mechanical aids to perform the operation and (2) faulty mechanical-handling equipment. There is, of course, a third source which does not involve equipment—the human failing.

Materials storage is also a frequent source of accidents. Unstable piles of material; blocked aisles; materials placed in such a manner as to require reaching, twisting, turning, or shoving—all lead to accidents.

Today there are many hundreds of devices on the market that enable operators to handle and store materials without physical strain. It is the task of the planning engineer to become familiar with these tools and to engineer them into the layout design.

Technicians pour a heat of special alloy in the new Westinghouse Metallurgical Laboratory at Blairsville, Pa. Note the special protective devices and the design of the melting floor to permit maximum protection to the operators.

Why Is U. S. Industry Strong?

Automobile industry an example of successful application of American business principles

By William A. Hadley,[1] Associate Member ASME

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IF AMERICA wins today's struggle against Russia and her satellites it will be because of the strength of the industries of the United States. For this reason it is important to learn why U. S. industry is the world's strongest and how it differs from that in other countries.

One method of getting this information is to find out in what way the products of U. S. industry are superior to those from foreign factories. If this is known then it is possible to concentrate on how our factories operate differently in order to make the products superior.

Like many other engineers, the author wanted to know the answer to these questions. He recently spent a year in Europe visiting factories and questioning European engineers and factory managers to try to find the answers. This paper is a summary of the conclusions he reached.

Who Makes the Best Automobiles?

Automobiles are typically American and provide an example with which most people are familiar. For this reason the automobile makes a good illustration of both our industrial strengths and our shortcomings. Of course there are many kinds of automobiles ranging from little three-wheeled vehicles not much different from a motor scooter, up to very special machines built to establish speed records on the salt flats of Utah. However, when most people say the word automobile they are thinking of only those vehicles built for general highway use and we will use that definition here.

There is no question that the U. S. builds good automobiles which have a large sales appeal. Even in those countries where dollars are short there is a surprisingly large number of American cars. On the other hand, if we study the desirable qualities of automobiles we uncover an apparent paradox. The following is a tabulation of some of these qualities that are measurable, in the form of questions as to which country is excelling in each category.

1 Who makes the finest automobile in the world?
2 Who makes the cheapest automobile in the world?
3 Who makes the fastest automobile in the world?
4 Who makes the most stylish automobiles in the world?
5 Who makes the biggest automobile in the world?
6 Who makes the most expensive automobile in the world?
7 Who makes the most economical automobile in the world?

It is very easy to answer the first question because the "Rolls Royce" has been advertising for years that it is "The World's Finest Motor Car" and since no one, to my knowledge, has disputed this claim we must award this one to Great Britain.

As to the second question, up until recently the cheapest automobile was the French "Citroen 2 CV" but with the introduction of the new line of English Fords, the old Ford "Anglia," which has been renamed the "Popular," is slightly cheaper. Both sell for around $800 at the factory exclusive of taxes.

The question of the fastest is almost impossible to answer if the special automobiles are included, but since this is limited to highway-type cars, it would appear that the answer is either Great Britain or Italy depending upon which issue of the paper you have just finished reading and perhaps whether you are biased toward "Austin-Healys" or "Ferraris."

As to the most stylish, there is no question in my mind that Italy is the only answer. The Museum of Modern Art in New York, in its examples of good design, favored the work of Italian designers as did the unbiased automobile club in Holland, based on its latest show. Manufacturers in France and the U. S. have employed Italian designers or designs while the converse is not true. I understand also that some of these so-called "cars of the future" that the manufacturers are displaying are products of the Italian body shops.

The honors for the biggest fall either to England with the "Daimler," which is the heaviest, or to Russia for the "Zis," which is the longest.

The most expensive car in the world is made in Spain for around $20,000 under the name of "Pegasso," while the German "Trippel" is probably the most economical with its reported 62 miles per gallon.

How Do U. S. Automobiles Excel?

If we look back over these answers we find that the United States didn't qualify under any of these headings. This is surprising because the United States produces by far the largest number of automobiles (around 8 million of the world's $9\frac{1}{2}$ million a year) and owns twice as many as the rest of the world put together. It would appear that there is some measure of automobile quality possessed by American cars that was not covered by this list. If America produces the cheapest automobile, then the reason for our tremendous consumption of automobiles, on the surface, would appear to be justified; but checking automobile prices, we see that not only

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France and Great Britain but also Germany produce cheaper automobiles than we do but not nearly as many. To dismiss it as merely the result of "mass-production methods" in the United States is an easy but erroneous answer. Germany's "Volkswagen" ranks right under the American big three to beat most American cars for the number four spot in automobile production. The techniques and benefits of mass-production methods are well known in Europe, contrary to what most Americans believe.

The quickest way to illustrate the particular advantage that American automobiles have over others is to make a plot of the "factory prices" before taxes, against "weight," for all of the passenger cars in the world. When this is done on logarithmic paper, as in Fig. 1 (after the manner of Williams, et al.[2]), it shows a series of straight lines with Britain at the top, followed by Germany, Italy, and then France. The United States occupies the bottom two lines. This means that for all sizes of automobiles where there is a choice between American cars and others, you get more automobile for your money in the American cars. In fact, the U. S. is selling automobiles comparable to the rest of the world's luxury vehicles but at a price only equaled by some of the European "midget" cars.

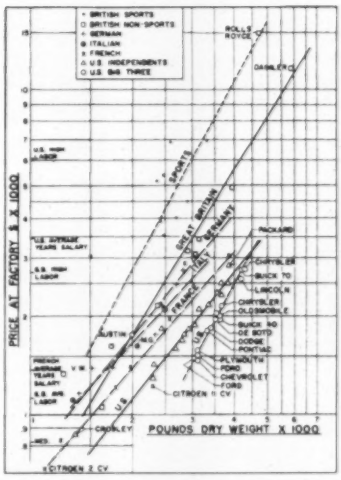

Fig. 1 Factory prices before taxes of passenger cars versus weight

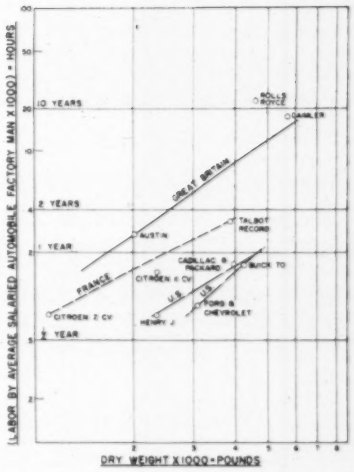

Fig. 2 Comparison of automobile prices and wages paid to automobile makers

The fact that these midget cars possess some intrinsic advantages that big cars do not have, such as economy, ease in parking, and so on, is not in dispute here. The relevant point, however, is that these small-sized cars are overpriced when compared to American standards. As regards the quality cars of the world, there is likewise little argument with the contention that the Rolls Royce and Daimler, for example, are finer cars than the mass-produced fine American cars such as the "Lincoln" and "Cadillac." This again is not the issue. The significant point is that the Rolls Royce sells for between three times as much, up to five times as much as these quality American cars and there is serious doubt that it is anywhere near that much better. (The Continental Mark II which compares in quality also approaches the Rolls price.)

Actually, comparing in terms of money is the least forceful way of describing this unique feature of U. S. industries. If we compare automobile prices in terms of wages paid to the labor which manufactures these same automobiles, the full impact is clearer. This sort of plot can be seen in Fig. 2 where it should be noted that an average British industrial worker must invest the equivalent of about one and one-half years' pay to ten years' pay to purchase a British motor car depending upon whether he chooses an "Austin" or a Rolls and obviously there is no choice available to him. The average American automobile worker can buy "Packards, Cadillacs, and Lincolns" for less than one year's pay down to as little as half a year's pay. It is almost unnecessary to add that American factory workers actually do purchase Cadillacs. The ability to buy automobiles by labor in other countries varies in general between these limits with the exception of Spain where I should hate to try to estimate the number of years' labor that is represented by the price of a Pegasso.

Therefore another way of accounting for the high volume of products that stream from American factories is the fact that all of the U. S. products are reasonably priced in terms of the hours of labor required to produce them. This is not merely a statement that U. S. labor has a high productivity. It is true that the low price (in labor hours) is accounted for by labor's own efforts but other factors are also important.

How Do We Get Low Prices?

It would appear that these low prices and also labor's motivation to attain high productivity are the result of certain American traits of character; furthermore, it is these same traits of character that Europeans find so objectionable in the Americans they meet in Europe. The European is very envious of our effective low prices but contemptuous of these character traits without realizing their connection.

For example, a party of American tourists, whether visiting the Peace Palace in The Hague or viewing the dyke that converted the Zuyder Zee into a fresh-water lake, will invariably want to know the costs of many of the items involved. On the other hand, a party of Europeans rarely raises the question of costs. This constant preoccupation of Americans with the cost of things is one of the traits that annoys Europeans. However, if we carefully examine piece by piece an American machine and a similar foreign product, almost every machine part will show that the American design engineer, in contrast with his European competitor, tends to restrain those design features that adversely affect cost if the quality gained thereby is small. This is not due to variations between engineering teaching in America

[2] "Standardizing Cost Data on Process Equipment," by Roger Williams, *Chemical Engineering*, June, 1947, p. 102; "'Six-Tenths Factor, Aids in Approximating Costs," ibid., December, 1947, p. 124.
"Cost Data Correlated," by C. H. Chilton, *Chemical Engineering*, June, 1949, p. 97.

as compared to Europe (the subject matter is amazingly identical) but is fundamental to the American designer because of his American habit of measuring everything in terms of money. The result of this sort of design is a tremendous over-all savings in labor and in costs.

The ability of the American engineer to restrain himself from designing the finest mechanism if, in so doing, it will require too many hours of labor to manufacture it, is beneficial not only in costs but is also a source of strength in war. Many Army men in the Tank Corps admit that the German tanks were superior in fire power and armor to our own. However, two American tanks together had more fire power than one German tank and also could outmaneuver it and our ability to produce tanks was an even greater ratio than two to one. If, on the other hand, we had designed tanks of superior ability but requiring more labor hours, we could not have produced as many.

Materialism provides part of the drive to keep up labor's productivity. Since we are always putting price tags on things we are more apt than Europeans to evaluate a man by the size of his pay check. If a man's worth is measured by his take-home pay, which evidences itself to his fellows by the things he owns, he is motivated to work harder and be more productive if he can thereby increase his income. This in itself favors high productivity, but since his income is measured by the things he owns, the purchase of these things, such as automobiles and TV sets, increases productivity even more by providing mass markets which must exist to achieve laborsavings by mass-production methods.

Another factor that spurs American labor to high productivity is our odd combination of a strong competitive spirit coupled with teamwork ability. The competitive spirit is best illustrated by contrasting the English sentiment of "May the best team win" with the feeling of the American baseball fan that no matter what, he wants his team to win. This spirit of competition is coupled in the factory with teamwork. Tom tries to out-produce Sam when they are working side by side but both are subconsciously working together in order that their department will show up better than the one on the next floor. European engineers and factory managers indicate that this does not exist in Europe.

Unfortunately, this same materialism results in many grotesque things such as the size, shape, and glitter of almost all American products. Since a man's worth is measured by the things he owns, in TV sets, for example, it is important to have a big-screen set even though the size of the room would make a small screen preferable in so far as picture clarity is concerned. Likewise, the excess chrome on automobiles is useless except as a designator of the price and year of the car, but with both the TV and the car the abnormality is ultimately linked to their bargain price. It would be nice if we could have one without the other but there is doubt as to whether that is possible.

Our Schools Strengthen Industry

The American high schools, which as educational institutions are perhaps inferior to their European equivalents, still contribute more to our industrial strength than would be obtained by employing the European system. Suprisingly enough, our high schools probably contribute more toward making our industry different from foreign industry than do our engineering schools. Our engineering schools, although excellent, are tending to become more and more like their European counterparts while our high schools are quite unique. Their uniqueness is due mostly to the fact that almost all of our citizens now go through high school as compared with roughly 10 per cent in Europe. The result of this is that, although the subject matter must be watered down in the United States so that the average student can grasp it, the leveling effect on all and the broadening effect on labor more than offsets the loss in curriculum to the top 10 per cent. The free exchange of ideas between labor, engineering, and management does not exist across the Atlantic where education is separated into social strata. Even the recently graduated engineering student is set quite apart from labor in Europe which definitely limits his usefulness and professional growth although it does perhaps flatter his ego. Furthermore, the American factory foreman is quite different from his counterpart in the rest of the world as he is the only foreman who is truly a part of management and is entrusted with executive responsibilities. The American high school gives him the necessary background for his job. Abroad where this sort of man is not available, production lags because authority cannot be delegated. Owing to the resulting concentration of authority, necessary decisions are either delayed or not made at all.

There is a saying in German that a person's strengths are the result of his weaknesses. It appears that this statement can be applied appropriately to American industry. Our industrial abilities which result in the uniquely American situation wherein the man who works in a factory is able to afford the products of his labor, are intrinsically tied up with our materialistic view of life. The concept that products should be made available to all is made possible because the same concept is applied to our educational institutions which sometimes necessitates the dilution of their teachings.

Today's Challenge

This inventory of the roots of our industrial strength is especially timely as it is more important now than ever to keep our industry strong. The United States is opposed today by an industrial nation led by men well acquainted with technology. Malenkov for one, is a mechanical engineer, and Russia, in an effort to surpass us industrially, is graduating more engineers than we are. If materialism is a fundamental source of our industrial strength, then it is possible for the materialistic Russians to develop the same sort of virile industry as our own. They are apparently studying the needs of their industries and we might be wise to do likewise. However, in America, we mechanical engineers working with our foremen and labor have achieved a system whereby the products of our factories are actually available to all the people, in contrast to the situation in Russia where the factory products are theoretically available to all but actually are unobtainable. This situation not only sets us apart from the Russians but is something of which we mechanical engineers in the United States can be truly proud. It is also a much finer thing than striving for perfection in any single category, if perfection can thereby be made available only to a favored few. If we engineers keep this goal in mind, our industry should be capable of meeting any wartime or peacetime challenge that it may be called upon to face.

Multifuel-Firing of Cyclone Furnaces

By G. A. Watts[1] and W. L. Sage[2]

The Babcock and Wilcox Company, Research Center, Alliance, Ohio

The cyclone furnace was developed to burn low-grade bituminous coals which normally have a high content of low-fusing-temperature ash. The application of the cyclone has since been broadened to include a wide range of coals; also the firing of gas or oil, either in combination with coal, or as stand-by or substitute fuels. Recent developments have shown that the cyclone is also capable of burning waste or by-product fuels, such as wood, chars, and cokes. This paper reviews the laboratory and field experience on the suitability of the cyclone furnace for these various applications.

Recently there has been an increasing demand for utilizing the merits of the cyclone principle in multifuel burning to dispose of waste materials or to take full advantage of price fluctuations and availability in the fuels market. Although the cyclone furnace was originally developed for burning coal, it is also suitable for burning a number of alternate fuels or fuel combinations (see Fig. 1). This paper reviews field and laboratory experience and describes some of the recent developments in the use of the cyclone as a multifuel burner.

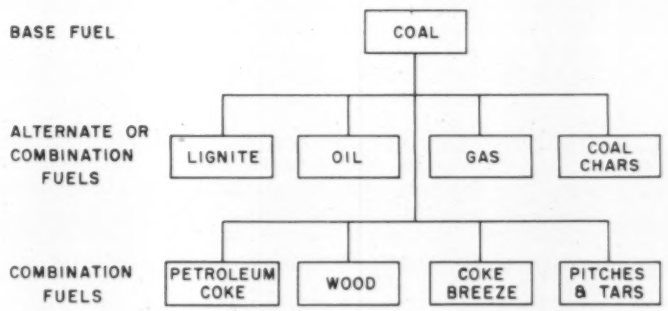

Fig. 1 Various fuels that are suitable for use in cyclone furnaces

The cyclone furnace, Fig. 2, can be described as a water-cooled horizontal cylinder in which fuel is fired, heat released at extremely high rates, and combustion essentially completed. Combustion air is admitted tangentially to create a whirling or centrifugal action which causes the solid-fuel particles to move to the periphery of the combustion chamber where their movement is retarded by the molten slag covering its walls. Although the finer-fuel particles burn in suspension, the cyclone method of combustion is primarily a surface-burning process. Full-load heat-release rates in present-day cyclones are approximately 800,000 Btu per sq ft-hr of wall surface.

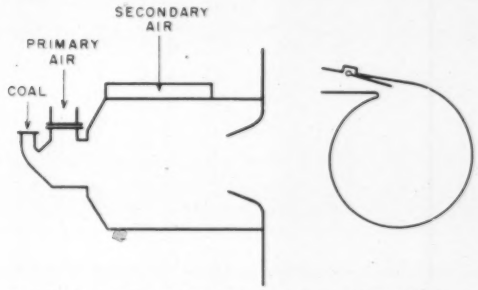

Fig. 2 A schematic diagram of the cyclone furnace

Essential Requirements of Fuels for Cyclone Firing

The suitability of a solid fuel, a combination of solid fuels, or a combination of solid and liquid or gaseous fuels for cyclone use depends upon the ability to maintain a liquid-ash coating on the walls of the cyclone and ignition stability. Liquid or gaseous fuels burn in suspension and do not need a liquid-ash coating on the furnace walls.

Liquid-Ash Coating. To maintain a liquid-ash coating, a solid fuel must have a sufficiently high ash content and the ash must be liquid at the temperatures existing in the furnace. The minimum amount of ash required for this purpose has not been determined specifically but experience with petroleum cokes indicates that at least 4 per cent is desirable. As far as the upper limit is concerned, it has been found experimentally that an ash content equivalent to 50 per cent of the dry weight of the fuel is about the maximum that can be handled satisfactorily.

The flow characteristics of an ash in the liquid range are dependent on chemical composition. Within the usual range of chemical percentages encountered with coal ashes, the flow characteristics can be predicted quite accurately. For trouble-free tapping, a viscosity of 250 poises has been established as the suitable fluidity for normal slag-tap operation. Since cyclone operation is predicated on maintaining a free-flowing slag on the

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walls, there is obviously an upper limit to the ash-fluid temperatures. Experience with a wide variety of coals, both in the laboratory and in field units, shows that this limit is not as sharply defined as might be expected. Consequently, as the upper limit of slag viscosity is approached, additional care is required to maintain slag flow at the furnace tap, and there is a tendency toward higher unburned-carbon losses.

Based on a great many tests, it has been established that a viscosity of 250 poises at 2600 F is about the upper limit at which slag can be tapped from a conventional cyclone furnace when using 600 F combustion air and a fuel containing 20 per cent or less moisture.

Ignition Stability. Ease of ignition depends primarily on two major properties of the fuel: namely, its moisture content and the amount of volatile matter it contains. High moisture content can be compensated for by increasing the temperature of the combustion air and by increasing the contact time between the primary air and the fuel before they enter the combustion zone. The volatile content of a fuel as determined by ASTM methods, although related to ignition characteristics, does not give a complete measure of the ease of ignition. Coals containing as little as 8.5 per cent volatile matter have been burned satisfactorily in laboratory units without the aid of a supplementary fuel. By-product fuels, such as cokes or chars prepared at 800 F or higher and having higher volatile contents, are more difficult to ignite.

Scope of Test Work

Originally, the cyclone was designed to burn bituminous coals, but, early in its development, experiments were conducted on the use of natural gas and oil as alternate fuels. Several other commercially available fuels also have been test-fired in field units.

In order to exploit development beyond that possible on commercial units, the Research Center of the authors' company is using three 5-ft-diam cyclone units and a 2-ft-diam unit. These units are of similar configuration to that shown in Fig. 3. They are used primarily for development work, although they also are playing a significantly important part in the studies of multifuel firing.

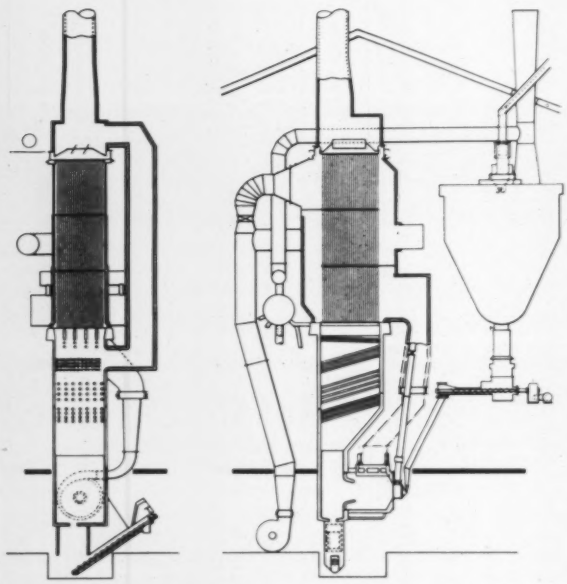


Fig. 3 Coal-burning cyclone of 5 ft diam at the Research Center; rated fuel capacity 120,000,000 Btu per hr

Coals. Since bituminous coals are the basic fuel for cyclones, development work has been concentrated, for the most part, in this field of application.

The range of analyses for the bituminous coals which have been test-fired in a cyclone unit is as follows:

	Per cent
Moisture	2 to 20
Volatile matter (dry basis)	18 to 45
Fixed carbon (dry basis)	35 to 75
Ash (dry basis)	4 to 40

Of the known bituminous coals mined in the United States, all have sufficient volatile matter and low enough moisture content to provide stable ignition in a cyclone. The limiting factor in determining their suitability is the ash-flow characteristics as stated previously; a viscosity of 250 poises at 2600 F or lower is desirable for satisfactory tapping. Approximately 75 per cent of the coals mined in the United States meet this requirement.

Anthracite coals have ash-fusion temperatures which generally class them as unsuited for cyclone use. However, an anthracite containing 4.5 per cent volatile matter was test-fired in the laboratory using a flux to reduce its normal ash-fusion temperature of 2900 F. Although ignition was stable with 800 F combustion air, the unburned carbon losses were high.

Lignites.[3] With the growth of the power industry in the areas near the Dakotas and Texas, there is an increasing demand for the use of lignites as low-cost fuels for power generation.

The range of analyses for lignites which have been test-fired in a cyclone furnace is as follows:

	Per cent
Moisture	28 to 45
Volatile matter (dry basis)	36 to 65
Fixed carbon (dry basis)	20 to 45
Ash (dry basis)	8 to 43

Lignites can be classed with bituminous coal in so far as their suitability for cyclone use is concerned. Their higher moisture content causes some reduction in furnace temperature and requires somewhat lower ash-fusion temperatures than do bituminous coals. About 45 per cent is considered as the upper limit for moisture content. In using lignites, a direct-fired application is recommended in which an individual crusher is provided for each cyclone to permit partial drying of the fuel before it enters the cyclone.

Lignites can be blended successfully with other fuels provided the limits of moisture content and ash viscosity are not exceeded.

Gas. In some sections of the country where coal serves as the major source of fuel for power generation, natural gas is available during certain seasons of the year at reduced or "dump" rates. To take advantage of these lower fuel costs, it is highly desirable that boilers be equipped to burn gas.

Thirty per cent of the cyclone-furnace units which have been sold are equipped for auxiliary gas firing. A number of units burn gas for long periods as it becomes

[3] Sub-bituminous coals are included with lignites.

available at dump rates. The gas is admitted to the cyclone furnace through two open-end nozzles located in secondary air ports, as shown in Fig. 4.

Oil. In some localities, fuel economics dictate that a power-plant operator be in a position to use either coal or oil. Such operators, generally speaking, may be divided into two categories: (1) Those who normally burn coal but purchase oil from the open market as its price becomes favorable; and (2) those who now use fuel oil exclusively but foresee the need for changing to coal at a later date.

The development of the cyclone to utilize oil and coal

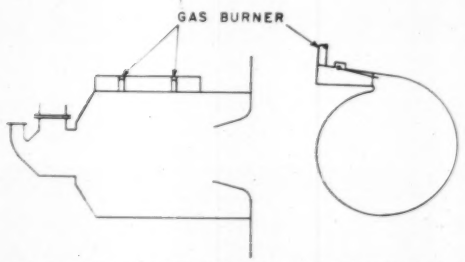


Fig. 4 Diagram showing gas burners in cyclone furnaces

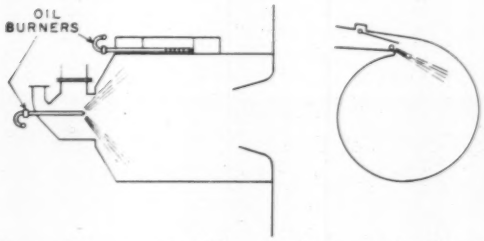


Fig. 5 Diagram of oil burners in conventional coal-fired cyclone furnaces

as alternate or combination fuels was undertaken to meet these needs. The cyclone furnace, when burning a solid fuel, requires higher static air pressures than other conventional types of fuel-burning equipment. When burning liquid or gaseous fuels, however, this high air pressure is not required.

About 20 per cent of the commercial cyclone-fired units are now equipped to use oil as a supplementary fuel either in combination with coal or by itself. A coal-burning cyclone can successfully burn any oil that can be sprayed into its interior.

At the present time, two methods of introducing oil into the cyclone are used with the range of air pressures normally required for burning coal. These methods are illustrated in Fig. 5. In one, the oil spray is located in a secondary-air port. In the other, oil is sprayed from a pipe inserted at the low-pressure core or vortex of the cyclone. Either of these methods is capable of developing full cyclone capacity. The choice depends on the application. The oil burner located at the secondary-air port can be left in position at all times without any danger of overheating because it is cooled by the secondary-air flow. The oil burner at the vortex is desirable when oil is to be burned for long periods, since it is accessible from the operating floor and is conveniently located for observation. With either location, no attempt is made to atomize the oil, since the velocity of the combustion air and the temperature of the cyclone furnace sufficiently accomplish this. Oil is ideal for supplementing solid fuels in the cyclone.

When oil is burned as an alternative fuel for extended periods, it is economically advantageous to operate at lower air pressures. Laboratory studies have shown that the pressure drop can be reduced appreciably in a standard coal-fired cyclone when it is used for firing oil if the percentage of primary air is increased. However, with the reduction of combustion-air velocities it is necessary to atomize the oil. Although this feature has been demonstrated on one of the cyclones in the laboratory, it has not been used commercially to date.

Wood. Industries which use wood as a raw material have waste material in the form of bark, sawdust, chips, and so on, of adequate heating value to supply a part of the fuel requirements. Therefore it is advantageous to burn these wastes in combination with the normal fuel supply of oil, gas, or coal if possible.

Tests have been conducted at our Research Center in which mixtures of wood bark and bituminous coal have been burned successfully. Up to 40 per cent of the heat input was obtained from the wood as received. The measured ash carry-over was comparable to that obtained when firing coal alone.

The high moisture content of the wood waste tends to lower furnace temperatures and to impose limitations on the ash viscosity. However, wood bark in general has a high calcium content, a known flux for most coal ashes, so that the ash produced when firing a combination of wood and coal generally has a lower fusion temperature than that of either the coal or the wood ash.

Using oil as a base fuel, it has been possible to obtain up to 50 per cent of the heat input from the bark. Pertinent data and fuel analyses for typical tests are shown in Table 1.

Table 1 Data for Firing Wood Bark in Alliance 5-Ft Cyclone

Test date	—7-15-55—		—3-16-56—		—3-26-56—	
Fuel	Coal	Wood	Coal	Wood	Oil	Wood
Per cent of total input	59	41	83	17	62	38
Moist as fired	3.5	39.9	5.0	57.1		52.6
Approx. analysis						
VM	39.2	73.1	41.5	75.1		75.7
FC	52.2	25.3	51.5	21.2		22.8
Ash	8.3	1.6	7.0	3.7	0.1	1.5
Btu/lb as fired	13200	5650	12900	3960		4450
Ash-fusion temp.						
Red. ID	2010	2050	1980	2100		
ST	2110	2110	2070	2150		
FT	2770	2340	2650	2220		
Ash analysis major constituents						
Si as SiO_2		33.0	45.0	35.0		50.0
Al as Al_2O_3		19.0	23.5	11.5		5.1
Fe as Fe_2O_3		11.0	24.0	12.0		5.0
Ca as CaO		25.0	2.0	35.0		26.0
Mg as MgO		5.0	0.7	1.0		4.9
Remainder		7.0	4.8	4.5		9.0
Per cent unburned carbon to stack	0.5		2.1		0.3	

Two units employing cyclone firing for wood waste in combination with coal have been sold and will soon be in operation. Fig. 6 shows the arrangement of one of these units.

***Petroleum* Coke.** Recent developments in the petroleum industry for the purpose of increasing yields of the

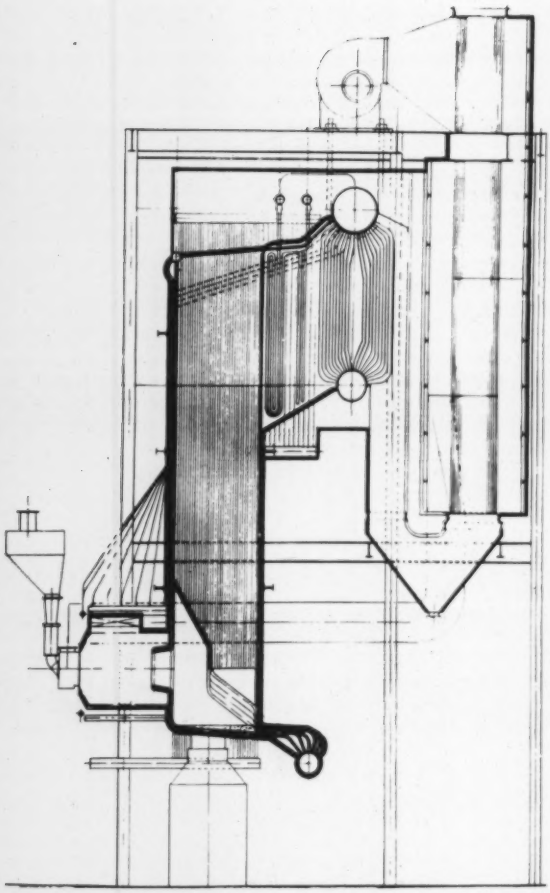


Fig. 6 Cyclone-furnace boiler for coal and bark burning, having a capacity of 150,000 lb of steam per hr, equipped with one 7-ft cyclone

lighter and more valuable constituents from the residual apparently will increase the quantities of solid petroleum by-products available for use as a boiler fuel. These fuels cover a wide range of analyses and physical properties. In general, those having a low volatile content are not suitable for use in conventional furnaces designed for burning bituminous coal, without the aid of a supplementary fuel.

The range of analyses for petroleum cokes which have been fired in a cyclone unit is as follows:

	Per cent
Volatile matter	5 to 15
Fixed carbon	85 to 95
Ash	0.1 to 0.4

Typical results obtained in the laboratory when burning a coke containing 5 per cent volatile matter produced by a fluid coking process are plotted in Fig. 7. When burning the coke alone, ignition tended to be unstable. By using 10 per cent oil or 30 per cent bituminous coal, ignition was stabilized. Without fly-ash collection, the unburned-carbon losses were high. However, by using collectors having 90 per cent efficiency and reinjecting the fly ash into the cyclone, these losses can be reduced to less than 1 per cent.

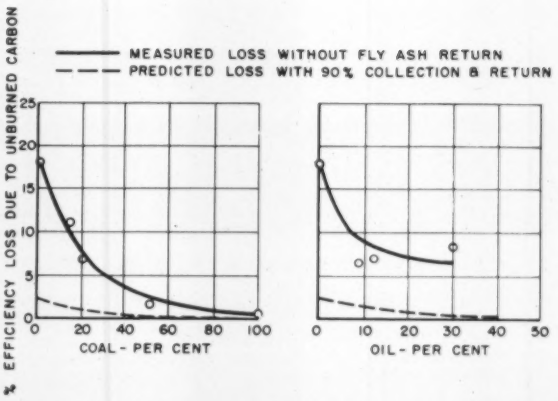


Fig. 7 Unburned-carbon loss to stack in laboratory 5-ft cyclone with 800 F combustion air; maximum of 10 per cent coke through a 200-mesh screen

Petroleum cokes in combination with coal are well suited for cyclone firing since the coal ash provides the necessary liquid coating. While these cokes also can be burned in combination with oil or gas the addition of a supplementary ash is required.

Furthermore, if used in combination with other fuels in the cyclone, fluid coke can be fired in the sizes as-received, thus eliminating preparation costs. The as-received sizing was approximately 98 per cent through a number-4-mesh screen and 5 per cent through 200 mesh.

A number of the commercial cyclone-fired units have been operated on blends of coal and petroleum coke containing 12–15 per cent volatile matter produced from pressure-still operation. During one series of tests, this fuel was fired alone for a period of 36 hr. Toward the end of these tests, ignition was not stable because the liquid-slag coating had disappeared and it was necessary occasionally to use a gas torch.

Petroleum Pitch. Work on petroleum pitch has been limited to one kind. Its analysis is as follows:

	Per cent
Volatile matter	64.1
Fixed carbon	35.5
Ash	0.4

Generally, petroleum pitch tends to soften at low temperatures and thus creates a handling problem. However, it crushes readily in a hammermill and, by using cold air, it can be introduced to a cyclone without difficulty. It burns easily because of the high volatile content. When used in a cyclone, sufficient ash quantity must be added to maintain a liquid-ash coating on the walls.

Coal Chars. Several processes for the carbonization of coal to produce tars for the chemical industry are being studied today and the chars obtained from pilot units have been tested in cyclones to study their burning characteristics.

The chars tested have had the following range of analyses:

	Per cent
Volatile matter	13 to 20
Fixed carbon	69 to 76
Ash	8 to 18

These process fuels are the result of heating high-volatile bituminous coals to obtain that portion of the

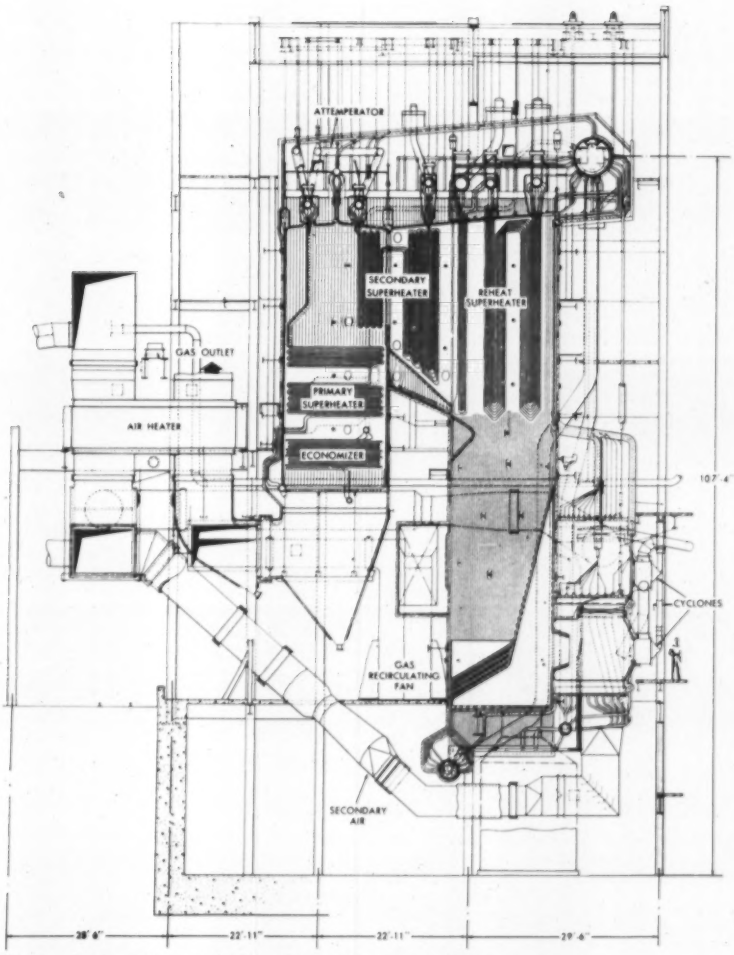


Fig. 8 Cyclone-furnace boilers for burning coal char, having a capacity of 1,500,000 lb of steam per hr, equipped with five 9-ft-diam cyclones

volatile material which is driven off at temperatures up to 700–1000 F. The volatile content of the remaining char, therefore, consists of the less readily volatile matter and causes these fuels to be more difficult to ignite than a coal having a similar volatile content. Results from a number of tests show that this handicap can be offset by increasing combustion-air temperatures and material fineness slightly above those normally used when burning a comparable coal. Under these conditions such chars have been burned successfully in the cyclone.

Two cyclone-furnace boilers have recently been sold to burn a 15–16 per cent volatile coal char and they will be in operation by 1957. These units, each of which is rated at 1,500,000 lb of steam per hr, are shown in Fig. 8.

Refuse Materials Containing Carbon. A number of waste materials whose carbon content can be salvaged to economic advantage are included in this category.

A limited amount of test work has been conducted with coal or oil and coke-breeze blends. Results indicate that stable ignition can be obtained with a 50–50 blend. Unburned carbon losses, however, are high.

Although injection of fly ash into a cyclone furnace is normally considered as a means of converting the ash to a more desirable granular form, this material often contains sufficient carbon to class it as a fuel. Fig. 9 shows the heating values of fly ash as a function of carbon content. A fly ash must contain 5.5 per cent carbon to supply sufficient heat to offset its melting losses. Any additional carbon above this amount serves as a supplementary fuel. One user who is presently injecting fly ash from his spreader stokers into the cyclone furnace is appreciably reducing his fuel costs.

Summary

Field experience and laboratory testing have established the fact that the cyclone furnace can be used to burn solid fuels such as bituminous coals, lignites, and coal chars individually or in combination. Liquid or gaseous fuels also can be burned in a cyclone as combination fuels, or as alternative fuels, at reduced air pressures to improve economy.

Other fuels that can be burned in combination with coal, oil, or gas include petroleum coke, petroleum pitch, wood waste, and coke breeze. When a combination includes a solid fuel, ash content must be sufficient to provide a liquid coating on the walls of the cyclone.

In general, these waste or by-product fuels can be used with little or no preparation; the major requirement is that they be fed to the cyclone at a uniform feed rate.

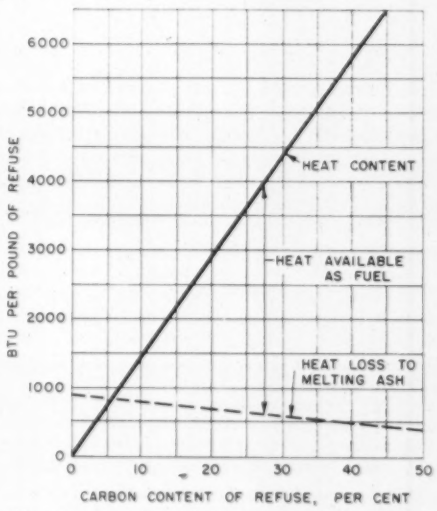


Fig. 9 Graph of heat recovered by fly-ash reinjection

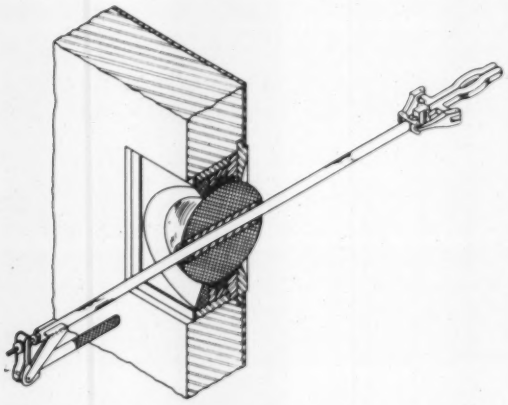
Remote-Control Handling Devices . . .

. . . for Conducting Research and Development Work Behind Shielding Walls of "Hot Labs"

By **Frank Ring, Jr.**, Member ASME

Superintendent of Design, Oak Ridge National Laboratory, Oak Ridge, Tenn.

Simple tong manipulator for drawing radioactive liquid into a glass pipette. The bottle is grasped by three prongs. A simple remote pipette manipulator just below the grasp tong draws the radioactive liquid up into the glass pipette. The third tool separates the glass pipette from the pipette manipulator for disposal.



Through-wall ball-socket tong manipulator. Clamping or tong action is controlled by a cable fastened to the squeeze handle and extending to the tong configuration. The ball and socket are usually constructed of lead to provide effective shielding equal to the shielding wall. Tong rotation and motions along polar co-ordinates can be obtained.

Much of the experimental and development work on radioactive materials which is done in the National Laboratories in atomic energy is carried on in facilities called "hot laboratories." These hot-laboratory facilities usually consist of a suitable building enclosure which houses thick-walled shielded cells in which the experimental and development work is carried on, disposal facilities for the radioactive wastes, and the necessary remotely operated tools and handling devices.

The hot laboratory is called upon to carry on remotely in its cells almost any development, test, or experimental work which is required to be conducted in a normal development laboratory and with the same degree of precision. To list several categories of hot-laboratory in-cell work we have the following:

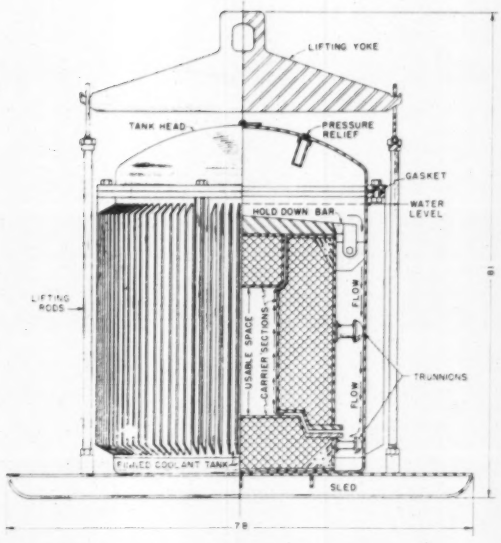
(*a*) Pilot-plant chemical processes.
(*b*) Metallurgical tests—such as profile, hardness, impact, tensile, and the preparation of metallographic specimens and photomicrographs.
(*c*) Process determination and sample analysis such as specific gravity, acidity, and quantitative analysis.
(*d*) General machining operations consisting of lathe work, drilling, milling, cutting, and grinding.

The cell-structure enclosures serve to attenuate the radiation (for the most part gamma radiation) and to protect personnel from the hazards of contamination from air-borne particles, vapors, and liquid penetration. Since mass with high density provides effective shielding against gamma radiation, the cell walls are usually constructed of lead, steel, or concrete.

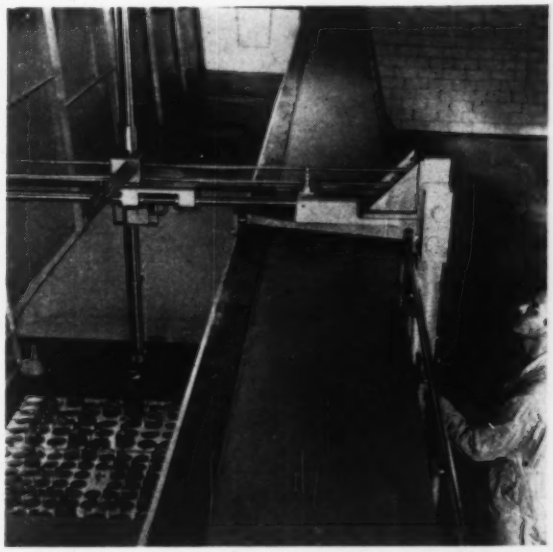
In present-day cell structures, lead and steel-wall thicknesses vary from 3 to 8 in. and concrete walls vary from 2 to 6 ft with the most common concrete-wall thickness now being 3 ft. Where levels of radiation are relatively low, distance in air provides a cheap shielding.

Since much of the hot-cell work on radioactive materials is done remotely inside of protective enclosures, a whole new category of long-handled tools, mechanical hands, and remote-controlled equipment has been developed. Some of these devices are shown in the accompanying illustrations.

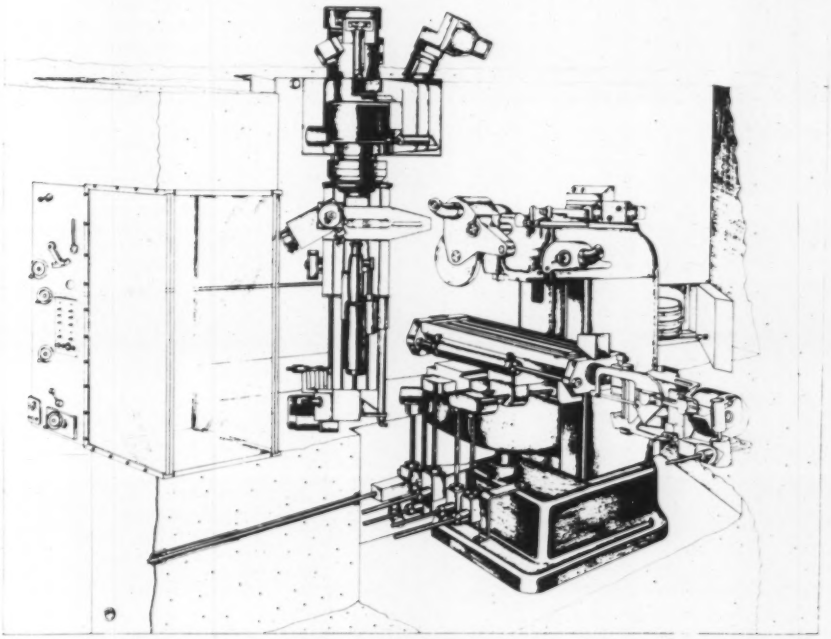
Contributed by the Machine Design Division and presented at the Machine Design Conference, Worcester, Mass., April 10–11, 1956, of The American Society of Mechanical Engineers. Based on paper No. 56—MD-4.



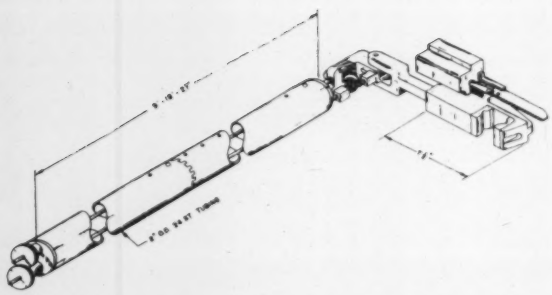
Large lead-shielded and water-and-fin-cooled carrier. The lead shielding is 10 in. thick and is encased in stainless steel. The lead shield can be removed from the carrier and taken apart for thorough cleaning. The carrier weighs approximately 6 tons.



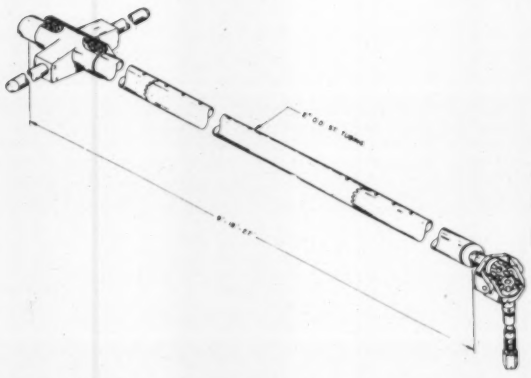
Manipulator used for the repetitive operation of remote handling of bottles of radioactive isotopes to and from a shielded storage area of the Isotopes Packing and Shipping Department at Oak Ridge National Laboratory. The operations are viewed through back wall-mounted mirrors.



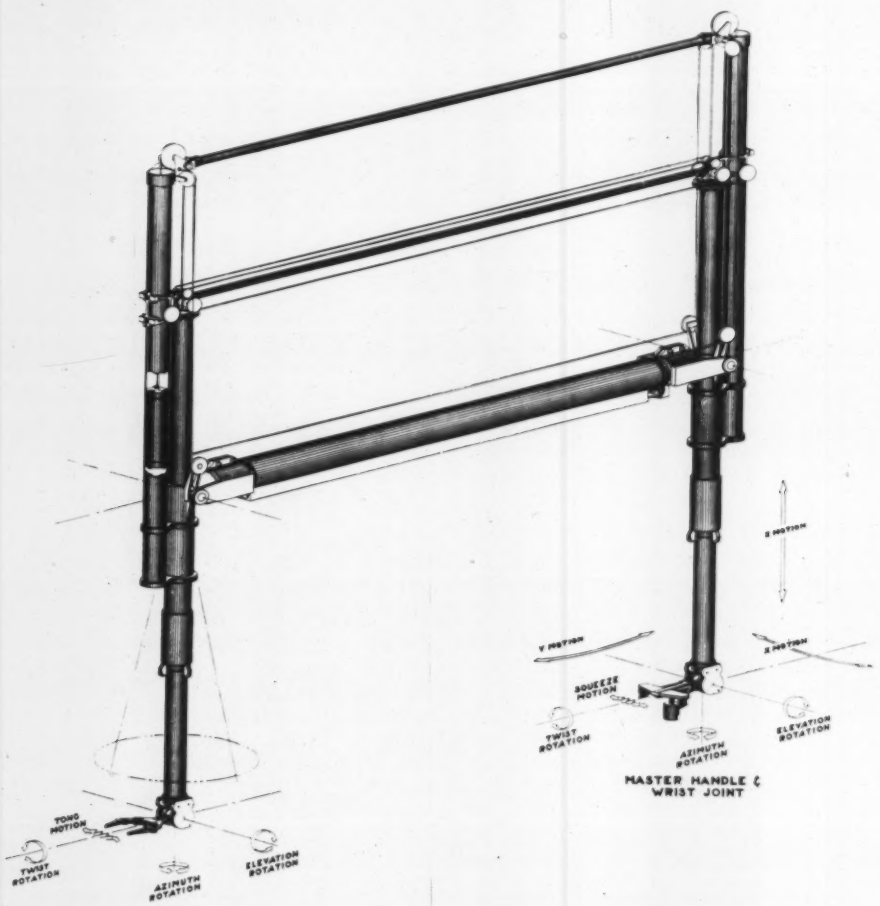
Remotely controlled machine shop located in one half a 6-ft × 11-ft cell enclosure with 3-ft-thick walls in the hot cells of the Solids States Division at Oak Ridge National Laboratory. The lathe is set up in a vertical position to save room and to facilitate chip removal. The milling machine is centrally located in front of the viewing window. A grinding head has been added to the milling machine. The controls for these machine tools are mechanical, hydraulic, and pneumatic. This shop is available to cut out and make up test specimens of all kinds from irradiated materials, to dismantle reactor components for investigational purposes, and to open irradiated experiments for examination.



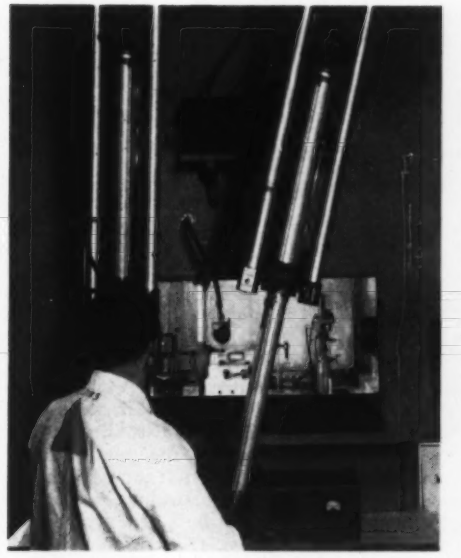
Hydraulically operated saw-and-vice arrangement, which can be rotated in two planes in order to reach down through a maze of piping and equipment. It is used at distances up to 27 ft to dismantle pilot-plant in-cell equipment which has been contaminated with radioactive materials.



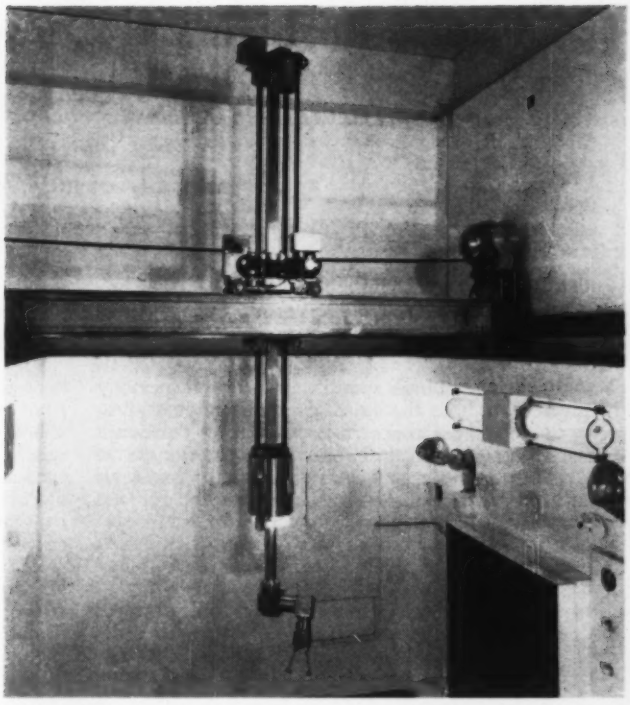
Long-handled socket wrench manually actuated. The angle of the socket is preset to any angle up to 90 deg. A piezo-type universal joint is used to transmit the rotating force. The wrench and the saw greatly reduce dismantling time by increasing the operator's allowable exposure time.



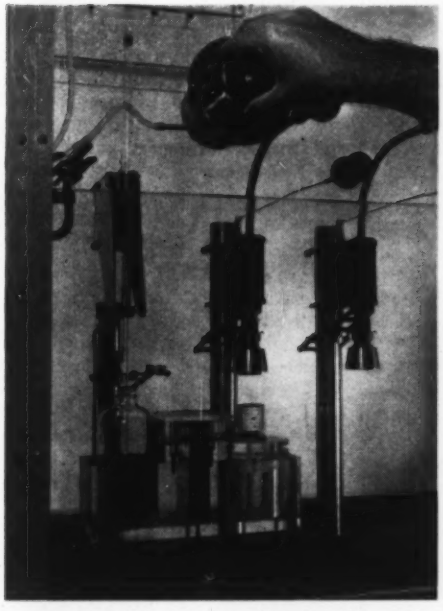
Argonne National Laboratory Model 4 Master Slave manipulator. Mechanically controlled, it is essentially a large pantograph. It reproduces shoulder-to-hand tong motions and features an excellent feedback of feel so that the operator knows exactly how hard a squeeze he is applying on delicate glassware and the like. The motions and forces are transmitted by the pantograph arrangement, the counterbalanced telescopic sections and tapes, and the sets of bevel gears. These manipulators are usually used in right and left-hand pairs.



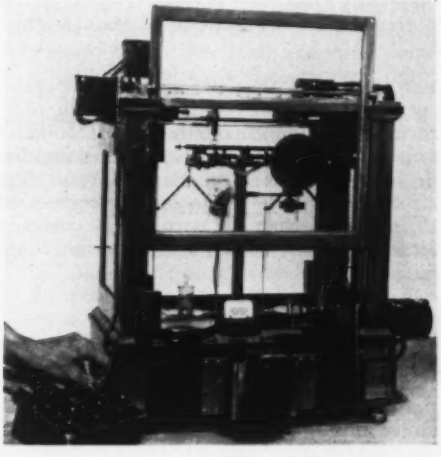
Argonne Model 8 Master Slave manipulators being used for some remote analytical chemistry manipulations. The manipulators are each inserted through an 8-in-diam hole in the cell wall.



Tell electric rectilinear manipulator. Two of these manipulators are in use in the hot cells of the Solid States Division in Oak Ridge National Laboratory. The Tell manipulator has the usual *x*, *y*, and *z*-motions for positioning and wrist swing, wrist rotation, and tong-gripping action and is rated at a 400-lb straight lift using a hook-type tong. Since this manipulator has no mechanical connection between master and slave, it can be used in totally enclosed cells and controlled from any practical distance.



Decapper and dispensing station for filling shipping bottles with radioactive liquids at distances as great as 10 ft. The liquid to be shipped is measured into the burette by remotely and hydraulically lowering the burette into the large storage bottle and turning the screw which actuates the bellows, which in turn causes liquid to be drawn up into the burette. The two decappers shown on the right remove, hold, and replace remotely the caps of both the storage and shipping bottles.



Standard chain-o-matic laboratory balance altered for remote control by the use of small fractional horsepower motors. By switch-positioning, the front and rear doors of the balance can be raised or lowered, the beam clamp locked and unlocked, the chain-o-matic device adjusted, and the beam rider weight moved. The scale pans are loaded by using a general-purpose remote manipulator.

High-Speed Problems of Large Airplanes

New concepts in aerodynamic design, structures, and materials must be evolved to operate successfully at high Mach numbers and high temperatures

By George S. Schairer

Assistant Chief Engineer, Seattle Division
Boeing Airplane Company, Seattle, Wash.

In 1956 the term "high speed" has a current meaning which starts at about the speed of sound and goes up to speeds two to three times that of sound. The word "airplane" denotes a winged vehicle flying in the atmosphere. The term "large" denotes not only a vehicle substantially larger in dimension than the small vehicles

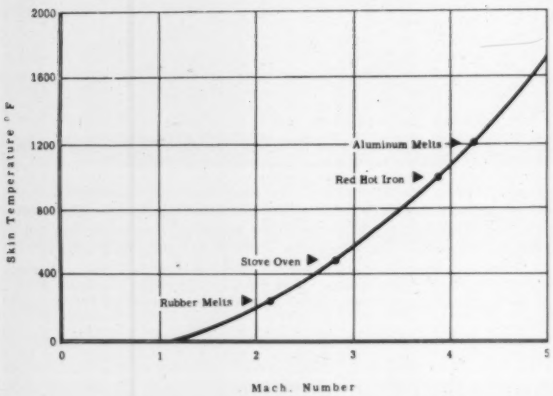


Fig. 1 Temperature rise as a function of Mach number

available, but also infers that the vehicle will spend substantial periods of time at its high speed. In addition, the term usually denotes an interest in the economics of the airplane in carrying a large pay load a long distance. It is for uses such as commercial transports that the author directs the discussion of high-speed airplanes. This means that the airplane is designed with full attention to all details which permit long-range operation.

Atmosphere

An examination of the atmosphere in which this high-speed large airplane will operate will point up the source and nature of many of the problems to be encountered (Mach number, indicated air speed, and total temperature). If high-speed flight is attempted at low altitudes, very high indicated air speeds result. However, by flying at altitude the indicated air speeds can be kept to values consistent with present-day experience. Above 35,000 ft, Mach number and true air speed are almost interchangeable in significance in discussing high-speed flight. Total temperature is the temperature encountered in bringing the air to rest at some portions of the airplane. Many parts of the airplane subjected to boundary-layer temperature will be at a temperature rise of only 84 to 90 per cent above ambient. In Fig. 1 the temperature rise at the bottom of a turbulent boundary layer assumed at 90 per cent of total temperature rise is given as a function of Mach number. This is a graphic demonstration of the temperature problem, the most obvious barrier to increasing speeds in airplanes which fly in the earth's atmosphere.

Materials

A great many papers have been written in the past two years on the subject of high temperature and what it means to the structures and materials engineer. The following comments will be directed primarily toward those problems which the airplane designer encounters.

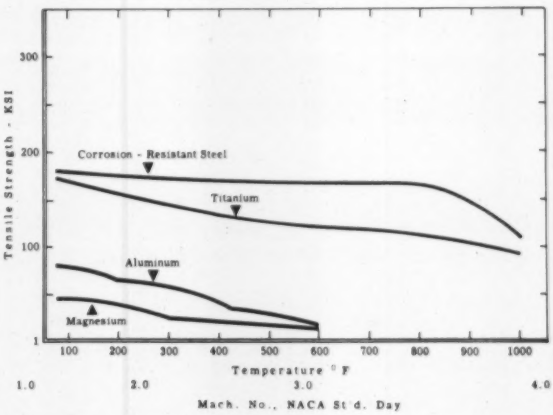


Fig. 2 Tensile strength of various materials versus temperature

In Fig. 2 it is seen that the short-time tensile properties of all materials decrease at high temperatures and that aluminum and magnesium encounter a major deterioration at about Mach number 2. Both titanium and steel have retained most of their strength at temperatures to be encountered up to Mach number 3.0. Fig. 3 presents

Contributed by the Aviation Division and presented at the Aviation Conference, Los Angeles, Calif., March 14–16, 1956, of The American Society of Mechanical Engineers. Condensed from ASME Paper No. 56—AV-24.

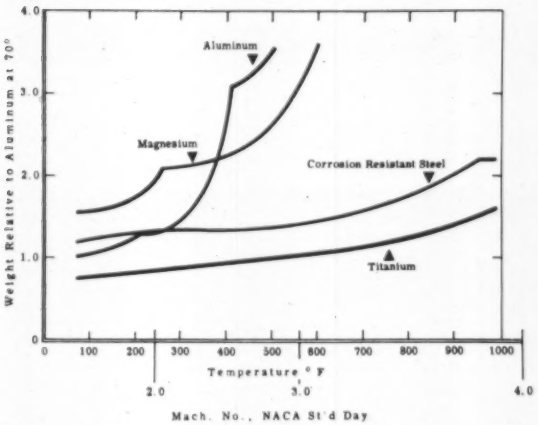


Fig. 3 Relative weight versus temperature based on tensile strength

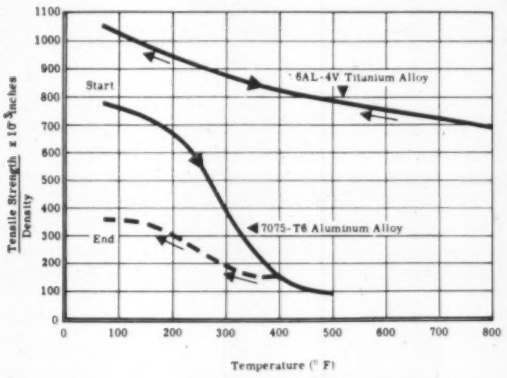


Fig. 4 Strength recovery after heating (500 hr exposure time)

the relative weight which must be used to carry a given tensile load. It is interesting to note that on a tensile basis titanium is the lightest material over the entire temperature range. Magnesium is noncompetitive and steel has properties approaching those of titanium.

The airplane designer is likely to encounter many applications where parts will be designed by low-speed low-temperature flight conditions. It is very important to understand the low-temperature properties of materials after they have been subjected to high temperatures for prolonged periods. In Fig. 4 no deterioration is evident in the titanium alloy. In the case of aluminum the high-strength characteristics cannot be counted upon at low temperatures after prolonged heating, and aluminum becomes a dubious material for use at speeds much above Mach number 2.

The modulus of elasticity plays a major role in determining the strength characteristics of composite structures subjected to compressive loads. The modulus is of utmost importance to the flutter and dynamics engineer. He is interested in the deflection which a structure will undergo when loaded, and the natural frequency of these structures. For common structural materials being considered for high-speed airplanes all suffer a deterioration of stiffness with increasing temperature, and aluminum and magnesium lose their stiffness at temperatures where their strength properties deteriorate.

Structural Design

The airplane designer finds that a substantial portion of the weight of an airplane structure is critically designed by compressive loads. The simple properties of materials as discussed in previous paragraphs do not apply directly to designing for compressive loads. Sheet-metal structures with thin skins incorporating conventional skin stiffening subjected to light compressive loads are incapable of developing unit stresses approaching the tensile strength of the material. Typically, to a first approximation the upper wing surface structure must carry a compressive load determined by external air loads applied relatively uniformly to the upper-surface skin structure. The designer then has the problem of placing a stiffened skin between front and rear spars which carries the full load for a minimum of weight. A convenient method of comparing various structural forms is in terms of structural weight per unit width and unit length divided by compressive load carried per unit width. This is a measure of structural efficiency in which the best structure has the lowest value of the parameter. In Fig. 5 it is noted that the efficiency of the structure improves as the unit loading increases. At low unit loadings it is difficult to obtain efficient structures with the more dense materials. It is characteristic that the sandwich constructions appear most desirable when using the denser materials. In fact, sandwich structures are an attempt to reduce the effective density of the material.

The high-speed airplane must sooner or later contend with the high-temperature problems of high-speed flight. In Fig. 6 the same structural-efficiency considerations are plotted for structures at 500 F. The efficiency of titanium and steel has not changed in any unexpected fashion. The aluminum structures are more or less out. Fig. 6 again confirms titanium sandwich for structures designed at high or low temperatures over the entire range of unit loadings. Suitable titanium alloys and methods of their fabrication into workable sandwiches appears to be an inevitable and most important, materials, manufacturing, and development problem.

Strength Diagram

Because of varying air loads and material strengths, a high-speed airplane will have strength properties which vary over its entire altitude and speed range. As speeds increase, the angle of attack decreases and the lift distribution will become sensitive to deflections of the wing. Most swept-back structures will tend to unload by decreasing the angle of attack of the outer portions of the wing. The strength of the structure decreases at high Mach numbers owing to increasing temperature. This decrease in material properties occurs in a region where the loads applied also may be decreasing so the resultant strength characteristics of the airplane can have some unexpected characteristics.

In Fig. 7 it is seen that the limit strength of the airplane wing increases with Mach number to just below the speed of sound at which point the allowable positive load factors are reduced materially. As the speed is increased further the limit strength increases and then decreases again at very high Mach numbers as the material properties deteriorate with high temperature.

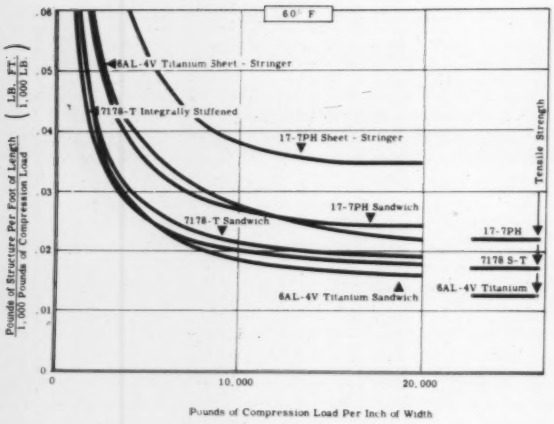

60° F
6AL-4V Titanium Sheet - Stringer
7178-T Integrally Stiffened
17-7PH Sheet - Stringer
17-7PH Sandwich
7178-T Sandwich
6AL-4V Titanium Sandwich
Tensile Strength
17-7PH
7178 S-T
6AL-4V Titanium
Pounds of Structure Per Foot of Length / 1,000 Pounds of Compression Load (LB. FT. / 1,000 LB.)
Pounds of Compression Load Per Inch of Width

Fig. 5 Efficiencies of structural panels in compression at 60 F

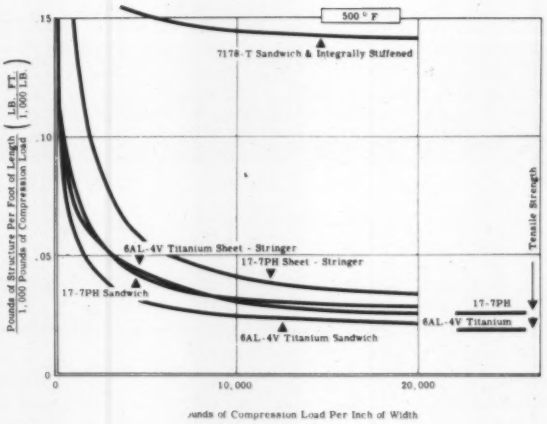

500° F
7178-T Sandwich & Integrally Stiffened
6AL-4V Titanium Sheet - Stringer
17-7PH Sheet - Stringer
17-7PH Sandwich
6AL-4V Titanium Sandwich
Tensile Strength
17-7PH
6AL-4V Titanium
Pounds of Structure Per Foot of Length / 1,000 Pounds of Compression Load (LB. FT. / 1,000 LB.)
Pounds of Compression Load Per Inch of Width

Fig. 6 Efficiencies of structural panels in compression at 500 F

It is seen that the structure has its minimum maneuver strength at sonic velocity and that the next lowest point is at the low-speed stall. In this case the maneuver strength of the airplane is determined in cold structures and the high-temperature structural problem is not designing.

Maneuver strength is only one of the structural criteria. An aircraft structure must withstand the gust loads to be encountered. The load factors produced by a large gust are shown in Fig. 7. Here again, the most critical condition is at the speed of sound. In this example the structure is not designed primarily at high temperatures, but must retain good properties at high temperatures in order to be nondesigning. A thorough study of each particular airplane is necessary before the design conditions which actually determine the structure can be understood.

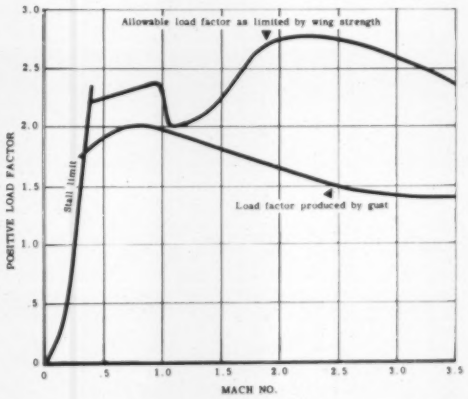

Allowable load factor as limited by wing strength
Stall limit
Load factor produced by gust
POSITIVE LOAD FACTOR
MACH NO.

Fig. 7 Typical velocity-strength diagram of a high-speed airplane

Creep

At elevated temperatures most materials become somewhat plastic and a phenomenon known as "creep" becomes important. Thus a wing will be subjected to permanent upward deflection following long positive loads at high temperatures. The rate at which permanent residual creep deflections are encountered is dependent upon the material, loading time, and temperature. It is evident that the rate of creep and the residual permanent creep deflection increase materially with the load carried. Large airplanes normally operate at significant stress levels, and creep in the structure may become an important designing condition. An airplane cannot withstand unlimited amounts of permanent creep deflection without assuming an absurd shape which will have a major influence on the functioning of its systems and its ultimate usefulness. The designer must establish criteria of allowable creep deflection which probably must be considerably smaller than 0.001 in. per in. This will require that the stresses at high temperatures be kept quite modest and may limit the duration of high-temperature flying hours.

Nonstructural Materials

The basic metallic structure is only part of an airplane and all other portions must be considered when designing to operate at high temperatures. Some of the materials of airplane construction must be cooled to acceptable limits. The most inflexible item of airplane equipment, if he may be so called, is the pilot and the other human beings aboard the airplane. The human body has the poorest tolerance to high and low temperatures of almost anything in an airplane. Serious consideration must be given to temperature-conditioning many other items such as the tires, since high-temperature rubber substitutes suitable for tires may or may not be developed by the time one wishes to fly at very high Mach numbers. In the design of large high-speed airplanes much effort will be required in the development of efficient light methods of temperature-environment-conditioning equipment for the various items where high-temperature materials cannot be used.

Aerodynamic Problems

Although the structural and high-temperature problems of high-speed airplanes have been highlighted in recent months, the aerodynamic problems remain quite tremendous. It must be assumed that the performance efficiency of a large high-speed airplane is of

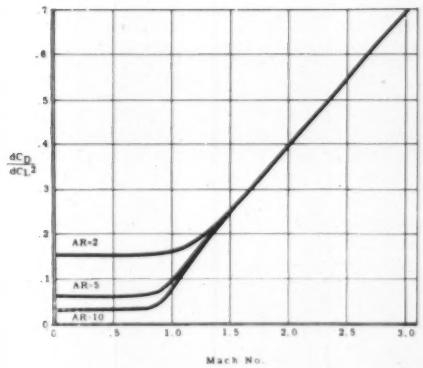


Fig. 8 Drag due to lift as a function of Mach number and aspect ratio

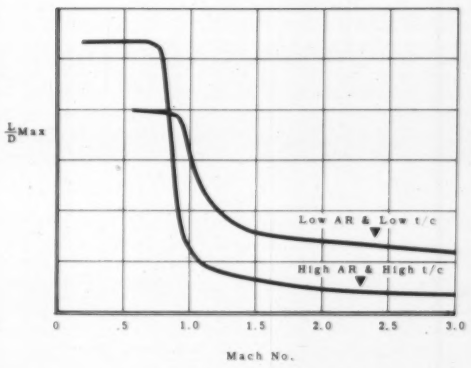


Fig. 9 Maximum lift/drag ratio versus Mach number

utmost importance since this is quite controlling in determining the amount of fuel and weight of power plant required to propel an airplane at high speed. The designer of the large airplane must, by definition, place great emphasis on the choice of features which will permit a low drag at high speeds. At supersonic velocities an increment of wave drag is added which is roughly proportional to the square of the thickness ratio. It can be expected that high-speed airplanes will be designed with the very lowest possible thickness ratios. Induced drag, or more strictly the drag which varies with lift, is also very important.

Fig. 8 presents the variation of drag with lift as a function of both Mach number and aspect ratio. In subsonic aerodynamics high aspect ratio is of little significance in determining the drag due to lift. Quite evidently, therefore, it can be expected that airplanes designed to fly at high Mach numbers will use relatively low aspect ratios, and the aspect ratio will be chosen almost entirely on the basis of considerations of subsonic flight. The high-speed airplane is likely to have somewhat poorer lift-drag ratios at subsonic speeds as compared to present-day equipment. This is shown quite clearly in Fig. 9. It is evident that the airplane designed with the low aspect ratio and low thickness ratio for flight at high Mach numbers will have a better lift-drag ratio at high Mach numbers than the typical present-day high-aspect-ratio high-thickness-ratio airplane. The difference at high Mach numbers is of several orders of magnitude. Since, to a first approximation, the range of an airplane is proportional to its lift-drag ratio, it can be anticipated that the airplane designer will have great difficulty in obtaining long ranges from his high-Mach-number airplane design.

Flying Characteristics

The aerodynamic design of an airplane is not all in the more glamorous performance features. The flying characteristics of an airplane are similar to the structure of an airplane in that they attract notice only when there is a failure. The large high-speed airplane will operate under conditions which open up many new stability and control design problems. Only a very few of these can be treated. One characteristic is a reduced aspect ratio. Aspect ratio appears as a major term in nearly all stability and control considerations. A large reduction in aspect ratio can very well require an entirely new approach to many stability and control problems. Typical of this is the down-wash problem. The down-wash produced by a given angle of attack of an airplane wing increases as the aspect ratio is reduced. If the down-wash angle is equal to the angle of attack, no variation in tail load with airplane angle of attack will be experienced and the horizontal tail will not contribute to the longitudinal stability. This may very well result in horizontal tail locations in unusual places, and in some cases in the elimination of the horizontal tail surface.

In some circumstances, supersonic aerodynamics provides solutions which differ quite diametrically from subsonic aerodynamics. Characteristic of subsonic aerodynamics is an influence of aerodynamic surfaces on the air flow well ahead of the surface. Conversely, in supersonic aerodynamics there is very little influence of airplane surfaces upon the air flow forward of the surfaces. A very important example of this is the case of control surfaces. In the subsonic case, the loading is more or less triangular both forward and aft of the control-hinge line. A high per cent of the load change caused by control deflection occurs on the fixed surface forward of the movable control surface. The load aft of the hinge of the movable control surface is effective at about one third of its chord. In supersonic aerodynamics, very little, if any, of the influence of control deflection is felt on the wing forward of the hinge line. Nearly all of the change in load occurs on the movable control surface itself, and this load is centered at 50 per cent of the movable surface chord. The implications of this are quite far-reaching in the design of large supersonic airplanes.

First of all it is evident that a given-size control surface will provide very much less control in supersonic flight than in subsonic flight. Furthermore, the hinge moment about the control-surface hinge will be very much greater in the supersonic case than in the subsonic case and the control will be very much more difficult to balance since the pressures available for balancing are less. This higher hinge moment combined with the reduced effectiveness will be a major problem in high-speed airplanes. The use of tabs to move the control surface and to balance them is also in question since the nature of the aerodynamics is such as to reduce materially the tab effectiveness under supersonic-flow conditions. Much ingenuity will be required and many designs will

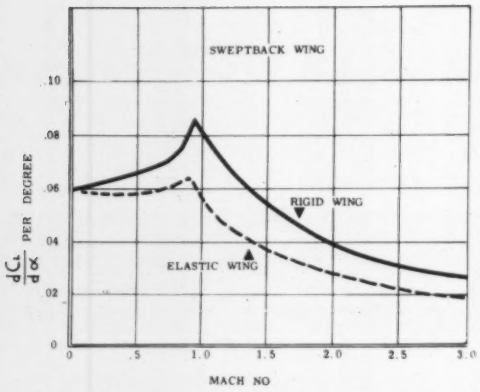


Fig. 10 Slope of lift curve $dC_L/d\alpha$ versus Mach number

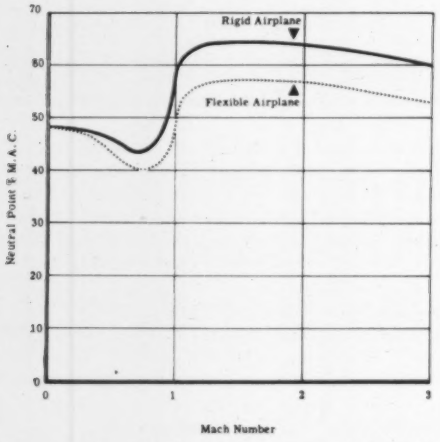


Fig. 11 Longitudinal-stability neutral point versus Mach number

be tried before a new pattern of supersonic-control design is adopted.

Of major importance in determining the characteristics of high-speed airplanes is the response of aerodynamic surfaces to changes in angle of attack. The variation in lift coefficient with angle of attack experiences large changes over the range of Mach numbers covered by high-speed airplanes. Fig. 10 presents a typical plot of the slope of the lift-curve slope versus Mach number. With swept-back structures, large unloading occurs due to deflection which results in a large reduction in the effective lift-curve slope. Much of the favorable strength characteristics shown in Fig. 7 are the result of this elastic deflection. The elastic deflections being encountered in airplane design are larger in each succeeding design. This is the result of the great pressure to use the lowest possible thickness ratio on high-speed airplanes. With the advent of lower aspect ratios, only small benefit will accrue since it is likely that all of the benefit of low aspect ratio will be absorbed by using lower thickness ratios. The airplane designer can look forward to spending a substantial portion of his technical effort in understanding elastic problems.

A direct corollary of the elastic problem is the variation in airplane longitudinal stability with speed. In swept-back airplanes the same deflection which reduces the loads carried by a wing at high dynamic pressures also reduces the longitudinal stability. Fortunately, in supersonic aerodynamics the aerodynamic center is in the vicinity of 50 per cent chord as contrasted to 25 per cent chord for subsonic aerodynamics. The result for a typical swept-wing airplane is shown in Fig. 11 where the neutral point for an assumed rigid airplane and its more realistic flexible characteristics are shown. A large gain in longitudinal stability occurs when going through sonic velocity. Otherwise, due to inflection, there is a continual reduction in longitudinal stability as the speed increases. The designer of large high-speed airplanes has always had great difficulty in providing adequate stability and control. It is evident this problem will worsen in the future.

Some Advantages

The foregoing account would lead one to suspect that all of the problems have ganged up on the designer of the large high-speed airplane. Although the designer may feel this way, there are numerous places where the large airplane has advantages compared to the small airplane. In supersonic aerodynamics a substantial drag penalty is encountered in providing internal volume. At constant wing loading the wing area, and hence gross weight, varies with the square of the linear dimension, but the internal volume varies as the cube. Hence the large airplane can more conveniently enclose its gross weight or can operate at a higher wing loading. This effect will most certainly favor the aerodynamic efficiency of the large airplane. It will be more convenient to enclose the fuel and other equipment in the large airplane.

The cooling problem also will be better in the large airplane since the mass goes up with the cube of the dimension and the area subjected to heating goes up as the square of the linear dimension. Actually, it is as a result of these many scale and size effects that the large airplane is able to have a substantially larger range and pay-load carrying efficiency than the small airplane.

Summary

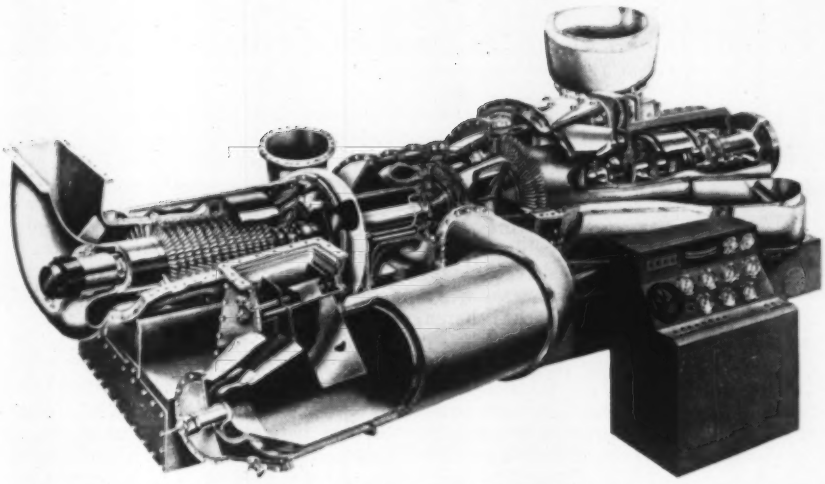
In summary, the large high-speed airplane will operate at high temperatures and high Mach numbers. Great emphasis will be placed on the development of titanium structures with sandwich arrangement. Temperature problems will be important in all materials used in airplane construction. Aerodynamic arrangements will lead toward lower aspect ratios and very much lower thickness ratios. These combined effects will give great difficulty in obtaining long ranges. The arrangements used in high-speed airplanes will result in entirely new stability and control problems and much emphasis on flexible airplane problems. Flutter will be a major problem. Many scale and size effects will be encountered which favor the large airplane.

Other problems, not touched upon, are: choice of power plant, design of power-plant inlet and exit, mounting of the power plant itself, design of the windshield and navigation equipment, the avoidance of collision, the provision of adequate low-speed flight characteristics, the reduction of power-plant noise all are of equal importance to the items covered in this paper.

Briefing the Record

Abstracts and Comments Based on Current Periodicals and Events

J. J. Jaklitsch, Jr., *Acting Editor*



Cutaway view of the Clark Mark TA, 1130 bhp, gas turbine for various industrial applications

1130-Bhp Gas Turbine

A GAS turbine which develops 1130 bhp and is well suited to driving portable or stationary generators, pumps, or centrifugal compressors was demonstrated recently by Clark Bros. Co. of Olean, N. Y., one of the Dresser Industries.

The Ruston Mark TA Gas Turbine, as this unit is known, is a development of Ruston-Hornsby, Ltd., Lincoln, England. An agreement was recently completed whereby Clark Bros. would manufacture and sell the unit in this country.

Similar in design to the Clark Type 302, 8500-bhp gas turbine, more than 40 Mark TA turbines are now in operation around the world. With the introduction of the Mark TA to this country, industrial users now have available a prime mover as modern as tomorrow's plant, that is light in weight, compact, air-cooled, has fuel flexibility, ruggedness, and long life.

Industrial Application

Where fuel economy is important it has an ideal application in those industries which require rotative power to drive generators, pumps, or compressors, and which also have a need for process steam. In these applications, which include the refining, petrochemical, and process industries, and practically any large industrial plant, extremely high thermal efficiencies can be realized.

Typical areas of use are gas and fluid transmission where the variable speed or high starting torque characteristics of a two-shaft turbine are required. The Mark TA has proved its efficiency as an emergency power-generating unit. Its light weight and small size permit use in locations where heavier units cannot easily be used; for example, on barges, boats, trailers, and so on.

Performance Characteristics

The gas turbine operates on a simple, open cycle. It is a dual-shaft, series-flow unit which develops 1130 bhp at 80 F and 1000 ft. The nominal low-pressure or out-put turbine speed is 6000 rpm. Output speeds of 1500 and 1800 rpm are available for driving 50 or 60-cycle generators. These speeds are obtained through the use of built-in planetary gears.

Variations of the low-pressure turbine speed in either direction from the standard 6000 rpm will result in a slight variation in power output for a given turbine inlet temperature.

Temperature and altitude have the usual influence on the turbine rating. A 3.5 per cent reduction of output is required for every 1000-ft increase in altitude; a 5 per cent reduction or increase for every 10 F above or below 80 F.

Many of the applications of this turbine have been a combination of waste-heat utilization and power generation or mechanical drive. When the back pressure is raised with a waste-heat boiler, the turbine must be derated as follows:

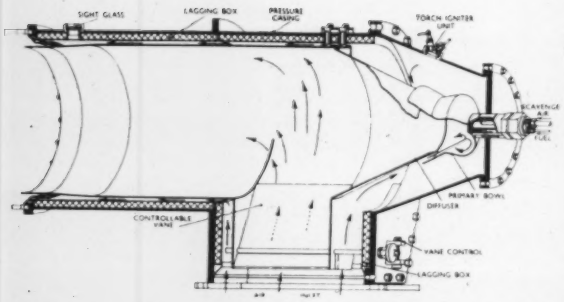
Back pressure at site				
Continuous rating, in. of water	2	4	6	8
Reduction at all loads, bhp	30	55	75	90

Thermal efficiency at full and part load:

Loading, per cent	Efficiency, per cent[a]
100	15.1
75	13.4
50	11.0

[a] Based on lower heating value.

The turbine is designed for normal operation at an inlet temperature of 1340 F for long life and depend-



Single combustion chamber and burner featured in Mark TA permits simple arrangement eliminating difficulties associated with multiple chambers

ability. The design permits full load within two minutes of initiating starting cycle.

Turbine Description

The complete turbine weighs approximately six tons. Normally furnished with a one-piece base, the unit can also be furnished with a two-piece base making it easily air borne or transported where weight or size is a problem. Three-point support of the unit assures proper alignment.

Gas Turbine Components. The turbine embodies the features of the Clark 302 turbine including a single combustion chamber, air cooling, long life, and easy accessibility for maintenance and inspection of all parts.

Axial Compressor. Combustion air is supplied by a 13-stage axial-flow compressor at a pressure ratio of 4.0 and a flow of approximately 22 lb per sec. The compressor is driven through a flexible coupling by the high-pressure turbine at approximately 11,500 rpm. The compressor case is split on the horizontal center line providing ease of assembly and accessibility. The compressor and turbine rotors are dynamically balanced.

Combustion Chamber. Liquid or gaseous fuel is burned in the air provided by the axial compressor. The heated gases expand during the high-pressure turbine and subsequently the low-pressure turbine. Combustion of the fuel is accomplished in a single, highly stable, elbow-type combustion chamber with a single burner. The chamber consists of two shells forming an inner combustion area and an outer annulus, capable of burning a wide range of liquid and gaseous fuels.

Turbine. The turbine consists of high and low-pressure units. The high-pressure turbine, which is a two-stage unit, operates at a speed of 11,500 rpm driving the axial compressor. The low-pressure turbine, which is also a two-stage unit, operates at 6000 rpm. The rotating blades are machined from bar and unshrouded. Blading of both compressor and turbines is designed on the free-vortex principle. The turbine blades are firmly anchored to the high-temperature stainless-steel disks by broached, fir-tree-type serrations. The stator blades are also machined from bar and mounted in 12 segments which are free to expand without disturbing the outer casing. Both blade roots and disks are cooled by air taken from the axial compressor. All parts are easily accessible for inspection or replacement.

Electrical System. The 30-hp starter motor and $2^1/_2$-hp auxiliary motor for fuel-oil and lube-oil pumps are supplied by a 24-volt battery system. The batteries are charged by an automatic battery charger which normally operates on 440-volt, 3-phase, 60-cycle a-c supply, but can be supplied at other voltages to meet various requirements.

Installation. Extreme versatility can be obtained on installation of the unit because compressor discharge, turbine inlet, and the compressor inlet volute can be rotated to any one of 24 positions. The exhaust ducting can be arranged for either up or down connections. The turbine can also be supplied on a skid base which requires no foundation.

Operations of Unit. Starting is accomplished by turning a single hand wheel. The turbine will accept full load within two minutes. The compressor is turned over by the 24-volt d-c starter motor. Subsequently, with the assistance of the burner, the compressor is brought up to a speed of 5000 rpm. At this speed the starting motor automatically disengages. The compressor and high-pressure turbine continue to accelerate to idling speed of 6000 rpm, where the governor takes over. During the starting cycle, lube oil (and, where applicable, the fuel oil) is supplied by auxiliary d-c motor-driven pumps which automatically shut off when the control wheel is set to the running position. At this speed, the engine-driven auxiliaries automatically take over.

Governing. The governor is a centrifugally controlled hydraulic type. The servo oil is supplied from the main lube-oil pump at 50 psi and controls the fuel flow. The permanent speed change between no load and full load can be adjusted, but unless otherwise specified, this is set to 4 per cent for parallel operation. When the load on the turbine is suddenly increased by an amount equivalent to 25 per cent of full load, the temporary or transient speed variation is approximately 5 per cent. On sudden load reductions of amounts equivalent to 25 per cent full load, the temporary speed variation is approximately 3 per cent. The speed may be controlled from a panel which may be installed on a generator switchboard some distance away to facilitate synchronizing and application of load.

Electronic Air-Warning Computer

THE first large-scale computer for the nation's vast, new, electronic air-warning network is being installed at McGuire Air Force Base in New Jersey. This "electronic brain" will become the first of the giant computers to fit into the integrated complex of radar, ships, jet aircraft, communications networks, missiles, and people, that is rapidly taking shape as the supersensitive continental air-defense system.

The project, known as the Semi-Automatic Ground Environment (SAGE) system, combines the abilities of the world's fastest electronic computer to receive information, to memorize, to calculate, and to record answers with the perspective and display talents of radar to present an instantaneous graphic picture of the location, speed, and direction of all planes within radar range. With a knowledge of flight plans of friendly planes available in the computer, hostile planes can be identified immediately and the most effective defense action taken—again on the basis of computer information and instruction.

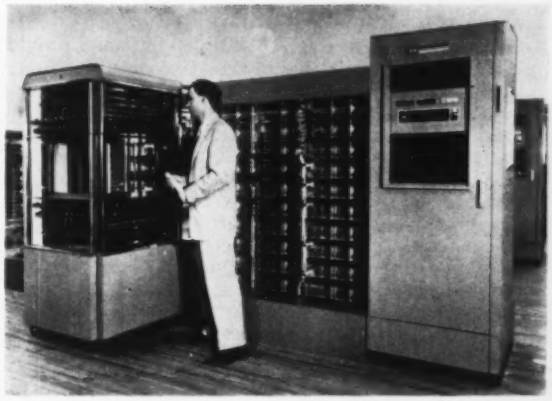
Designed by International Business Machines Corpora-

tion at its Military Products Division Laboratory, Poughkeepsie, N. Y., in co-operation with Massachusetts Institute of Technology Lincoln Laboratory, the computer was manufactured at the company's Kingston Military Products Division plant. Plans for production were laid in 1953 by IBM.

The SAGE system starts with a radar ring on land, on Navy picket ships at sea, on offshore Texas towers, and on air-borne early warning planes ranging far out over the ocean. These radars are linked by telephone lines or ultrahigh-frequency radio directly to the high-speed computer. Information about aircraft anywhere within the radar area is relayed continuously and automatically to the computer. This IBM-built equipment, called the AN/FSQ-7, digests all of this information plus ground observer reports, flight plans, and weather information as fast as it is received and translates it into an over-all picture of the air situation. These TV-like pictures show the air battle as it develops and provide the basis for the necessary human judgments.

The computer automatically calculates for the operator the most effective employment of such defensive weapons as guided missiles, antiaircraft batteries, and jet interceptors. In the case of the intercepting jets, the aircraft is controlled by directions fed by radio directly from the computer to the automatic pilot in the plane. Missiles are controlled similarly. At any time, the air battle commander can have the computer display the over-all air situation or whatever part of it he wishes to monitor in detail. As the battle moves, information is transferred spontaneously to an adjacent computer.

The SAGE computer incorporates many advanced electronic components. One of these is a high-speed magnetic core memory. The memory is made up of thousands of tiny, doughnut-shaped cores. Several cores in a row store a single word or number, the identity of which is determined code fashion according to whether or not individual cores in the row are magnetized. Data may be "read" into or out of this memory in millionths of a second, almost immeasurably faster than the speed of a hostile jet bomber, the computer also makes considerable use of such new and economical developments as printed wiring and miniaturized components. Many automated and semiautomatic manufacturing techniques are used throughout.



The heart of the AN/FSQ-7 air-defense computer is the magnetic core memory. This memory contains over 500,000 bits of high-speed storage with an access time of six millionths of a second to any group of 32 bits. It will contain the instructions that the computer will follow during its normal operation and the data which are being correlated and processed at that time. Power module is at *right*, memory frame in *center*, and memory array frame at *left*.

The display console presents a picture of the air-defense situation to the operating personnel and with the aid of the buttons and switches located on the side of the consoles, Air Force personnel will make tactical decisions which in turn will be carried out automatically by the computer. From this location, the operator can request additional information from the computer, can select certain features and exclude all others, can expand his scope picture to look at a smaller area, and will monitor the action of enemy planes and our own interceptors and guided missiles.

The AN/FSQ-7 is designed to operate 24 hours a day, 7 days a week. Facilities are provided so that preventive maintenance can be performed on the machine while SAGE data continue to be processed. The equipment being installed at McGuire is the first production computer. Engineering models of the computer have been installed for several months at Kingston and at Lincoln Laboratory of Massachusetts Institute of Technology in Lexington, Mass., where the system is being tested.

Included among other contributors to the SAGE system are Western Electric Company and Bell Telephone Laboratories of the American Telephone and Telegraph Company and Rand Corporation of Santa Monica, Calif. The SAGE system was developed by scientists and engineers at M.I.T.'s Lincoln Laboratory under contract with the Air Force. This program is being implemented through the joint efforts of the USAF Air Material, Air Research and Development, and Air Defense Commands.

Low-Cost Electronic Computer

A NEW electronic brain, the ALWAC 800 Series Electronic Data Processing System, with speed, storage capacity, and versatility at least equal to million dollar computing systems, but costing only one-eighth as much, has been announced by Logistics Research, Inc., Redondo Beach, Calif.

Costing about $125,000, the ALWAC 800 System, using 12 decimal digit numbers, is capable of 11,000 additions, 2000 multiplications, or 13,000 comparisons per second. The ALWAC's high-speed internal memory may be supplemented with up to 10 magnetic drum storage units,

each having a 12 million decimal digit capacity, and a 4-millisecond access time. Multiple-tape units provide greatly enlarged additional lower-speed storage. Input-output consists of punched cards, line printer, high-speed paper tape, and electric typewriter, as required.

Designed for an extraordinary range of data-processing application for business, scientific, and engineering use, the ALWAC Series 800 System, operating strictly in decimal mode, is constructed on the modular of building-block principle, allowing compatible expansion for the user's increasing data-processing requirements. The System's enormous data-storage capacity is of particular value for business applications. Series 800 System deliveries are scheduled from 12 to 18 months.

Supersonic Test Vehicle

A SUPERSONIC Lockheed test vehicle which has played a major role in the development of powerful new engines for Air Research and Development Command ramjet missiles was disclosed recently. It is X-7, designed and built by Lockheed's Missile System Division.

Details of the needle-nosed vehicle were revealed by Brig. Gen. Marvin Demler, Deputy Commander for Research and Development, of the Air Force's Air Research and Development Command, in an address to the Air Force Association in New Orleans, La.

Although exact performance is classified, it was revealed after several years of secrecy that the X-7 flashes through the stratosphere in level flight at speeds well beyond the velocity of sound.

"In our ramjet development program," General Demler said, "we have used the X-7 as a high-speed test bed to get test and design information in actual flight. Through this research and testing program, we are developing successful ramjets for operational use."

"Also," Demler added, "the supersonic vehicle has served as a test bed for the development of other important missile components."

According to Lockheed's missile scientists, the X-7, while not the first to use ramjet engines, is making important contributions to the development of the ramjet principle as a dependable new source of missile power.

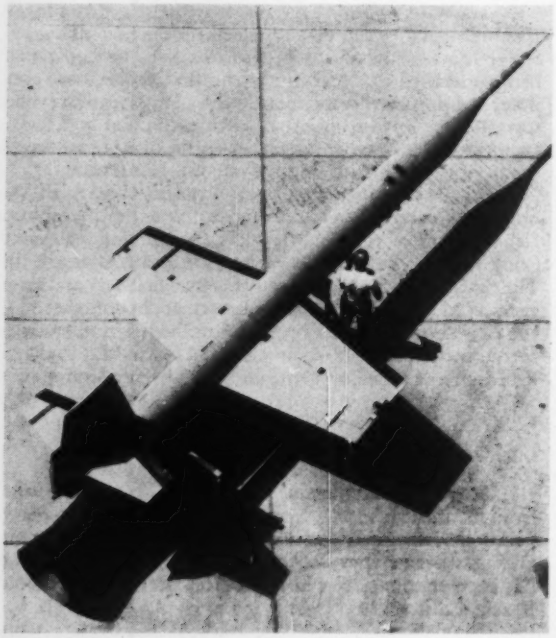
Ramjets, considered the ultimate in ducted-jet engines for guided missiles, are comparatively simple devices that give tremendous power at high speeds. Unlike conventional jet engines, the "flying stovepipes" have no compressors or other moving parts and depend upon their own high speed to compress their air intake. In general, the faster they go the better they operate—without the limiting factors, such as compressor speeds and heat, that limit conventional jets.

Much of the electronic gear carried by the X-7 and related data reduction equipment to decode flight information was developed by Lockheed scientists. The X-7 is being built at Lockheed's Missile Systems Division, Van Nuys, Calif. The ramjet engine mounted on the X-7 was developed by Marquardt.

In describing the operation of the X-7, General Demler told an Air Force Association audience that the test vehicle is taken aloft by a B-29 and then launched.

"A rocket booster drives it up to the speed where the ramjet operates efficiently and takes over to accelerate the vehicle," General Demler declared. "The supersonic vehicles are recovered by parachute and will be used again for future test flights."

"This," Demler stressed, "represents quite a savings in our testing program."



Supersonic Lockheed vehicle—designated the X-7—which is used in development of powerful new engines for USAF ramjet missiles. The needle-nosed X-7, launched from a B-29, is parachute-recovered to be flown again, representing an important saving in test-program costs.

Radar Ruler

RADAR now has a new use—measuring great distances for the surveyor.

The "radar ruler," developed by the Army's Signal Corps Engineering Laboratories at Fort Monmouth, N. J., gives the surveyor 20-league boots—freeing him from short-sighted optical equipment, useless in bad visibility.

With the radar yardstick, he can measure off 50 miles in a single giant leap instead of 20 or 30 small hops, each requiring meticulous sighting. Even at greatest range the radar readings are precise to within a few feet.

Designed under Signal Corps contract by Motorola, Inc., Chicago, Ill., the new system uses two separate jeep-portable radar stations, one at each end of the distance to be measured.

The radar's eye for distance is not hampered by bad visibility. Its long-range electronic beam easily penetrates fog, darkness, and foliage—impossible with conventional transit, plumb line, and rangepole.

This radar ruler is designed to replace standard surveying gear when long range and speed are essential. A complete double-checked distance reading takes less than five minutes.

The new radar ruler could save the lives of many troops in a future conflict allowing them to quickly pinpoint friendly battlefield installations from stations 25 or 50 miles behind the lines.

This radar ruler judges distances up to 50 miles—precise to within a few feet. The antenna, mounted on a collapsible mast in background, readily sees through foliage, bad weather, and darkness—three major obstacles to the surveyor today.

In civilian use, the electronic surveyor could speed mapping over difficult terrain and surveying over large bodies of water.

The entire radar station, a 25-ft collapsible antenna mast and three metal suitcases filled with electronic equipment, weighs only 200 lb. It fits easily into the back of a jeep and can be set up and operated by one GI.

A pair of antennas placed at the two distant points play radar catch with a signal, bouncing it back and forth thousands of times a second. Automatic computers count the catches and register the distance in terms of time the signal takes to make 10,000 round trips. Using a simple chart, the operator can quickly convert this reading to a high precision point-to-point measurement.

Induction Vacuum Melting

COMPLETION and start-up of a new induction vacuum-melting department at its Watervliet, N. Y., works has been announced by Allegheny Ludlum Steel Corporation. For use temporarily as a research and development project, the new facility is expected to be converted to a regular production status as soon as a number of research studies now under way are completed.

The new facility complements the production consumable electrode vacuum remelting department installed at the same location last year.

Extensive research and development programs are in progress on new high-temperature wheel and bucket alloys for gas turbines. High-temperature bearing steels, tool steels, alloys for magnetic applications, and alloys for specialized corrosion service are also being studied.

It is expected that the information gained during the operation of this equipment on a research basis will contribute much to the operation of this equipment as a production unit.

The induction vacuum-furnace installation is the result of years of specialized high purity metal-refining experience at Allegheny Ludlum. It incorporates a 300-lb furnace in its research and development configuration, and as a production unit will utilize a 2000-lb furnace.

The vacuum unit is of unique design which permits changing the furnace, pouring ingots, and removal of the completed heat while the vacuum is maintained in the main melting chamber. Thus a succession of melts can be made with melting being stopped only for crucible changes.

New Oxygen Process

A NEW process to produce high-quality steel faster and cheaper in its bid to meet the ever-increasing demand for more steel has been introduced by the steel industry, according to *Steelways*, published by the American Iron and Steel Institute.

The article said that the new oxygen steelmaking vessels can produce steel at the rate of more than 50 tons an hour compared with 20 to 25 tons hourly from modern open-hearth furnaces.

Operating costs of the new process are said to be substantially lower and the quality of the steel produced is comparable, for many purposes, to steel produced by the open-hearth method.

More than two million tons of oxygen steel were produced during the trial runs with "gratifying" results. This steel has been rolled, welded, bent, deep drawn, and subjected to myriad other exacting operations required in modern manufacturing.

Steelways said it seems especially suitable for making cold-rolled sheets, a tonnage product widely used in many of the mass-produced consumer products, such as automobiles and household appliances.

One of its most successful applications to date, the article noted, is in automobile fenders which are cold-formed in deep-drawing dies of huge presses. Only steel sheets of the finest drawing quality can qualify.

The tests showed that the oxygen steel performs equally well when drawn cold through dies to make wire or when rolled flat, slit, and welded into pipe.

The oxygen converters will be installed gradually at first to complement existing steel furnaces. Then, if operating experience remains favorable, steel producers will add them wherever they can be most efficiently employed.

Continuous Casting Tests

COMPREHENSIVE tests of the continuous casting of carbon steels have been conducted recently at Welland, Ont., by Inland Steel, Koppers Company, and Continuous Metalcast Company. This newly developed method of changing molten steel to molded steel in a continuously moving process eliminates the casting of

ingots in stationary molds, saves time, and minimizes the number of wasted end-cuts on ingots.

In the tests a series of rimmed, semi-killed, and killed carbon steel were cast. These steels were processed through the Inland plant at Indiana Harbor, Ind., and then shipped to customers and applied on regular production jobs. Slabs of 6 in. × 24 in. were cast from 30-ton heats. To meet Inland's minimum requirements, however, a machine for simultaneous casting of 175-ton heats in two 8-in. × 45-in. slabs was projected. This operation was much larger than any previously conceived.

Ten installations of the same type of continuous casting machine have been made or are proposed in other countries.

Steel Output

More than 122 million tons of steel were made in 12 consecutive months and more than one billion tons were produced since the end of World War II, according to *Steel Facts* for September, 1956.

The great surge of steel output began in mid-1955 and included eight consecutive months of more than 10-million tons' production each.

Americans were using more steel than ever before, and demanding large quantities for the construction of buildings, highways and homes; for household appliances, farm equipment, automobiles, and countless other products.

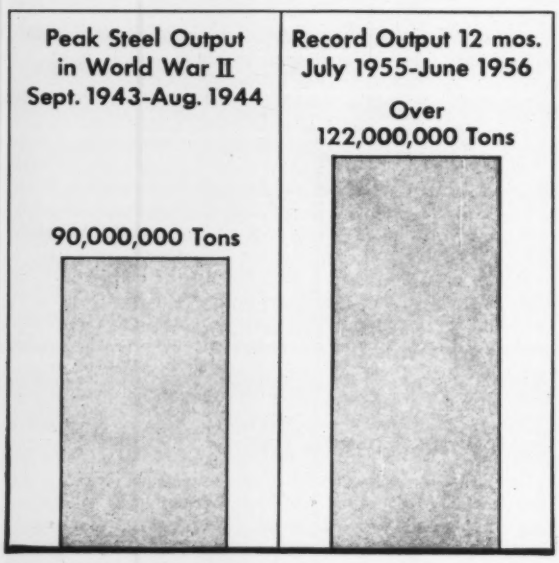
The steel-production feats were made possible by the steel industry's rapid expansion, paralleling the growth of this flourishing country. For both the country and the industry, the growth is continuous. No exact limits can be set for it.

If the steel companies had not pursued huge programs of expansion and improvement, at a cost of more than $7 billion during the past 10 years, the production of 122 million tons in 12 months, and one billion tons since the end of the World War II, would have been impossible.

Back in World War II, the greatest amount of steel made in 12 consecutive months was about 90 million tons, which then seemed enormous. But the recent 122-million tons record is 35 per cent higher than that war peak. The steelmaking capacity is now at 128.4 million net tons of ingots and steel for castings annually—with additional expansion and improvement programs totaling about 15 million tons scheduled during the three-year period, 1956–1958, inclusive.

The production of one billion tons of steel in 18 years from 1927 to the end of World War II also seemed startling in that era. But fewer than 11 years were required to make the most recent one billion tons.

The steelmaking furnaces in the United States set records in June and the first half of 1956, in addition to the record for the year ending June 30. The June record was 9,758,000 net tons of ingots and steel for castings. The first half total was 62,644,175. The 12 months' total was 122,473,958.



Comparison of steel production: September, 1943–August, 1944, against July, 1955–June, 1956

Metal Fatigue

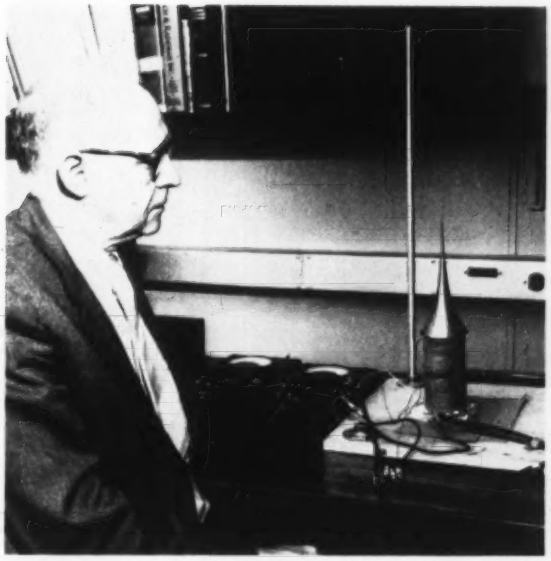
Fatigue occurs in metals when they are subjected to cyclical stress, evidencing itself by embrittlement and the development of "fatigue cracks," frequently with catastrophic consequences. The fundamental mechanism of fatigue has remained obscure even though its prevention is increasingly essential with the present trend towards complex equipment and supersonic flight. Now, however, new insight into the atomic processes involved is coming from research investigations at Bell Telephone Laboratories.

Novel techniques, born of communications research, have been applied by W. P. Mason of the Laboratories in obtaining significant new information on fatigue from studies of its relationship to "internal friction." In an ideally elastic metal, strain would be instantaneously proportional to a cyclical stress; but in all real metals stress and strain are not single valued functions of each other. There is a phase lag between them which is due to dissipation or internal friction.

To measure internal friction, a barium titanate transducer matched to an exponential horn-shaped metal element is employed to concentrate large strains in a small-necked down section of the metal. The internal friction, strain, and change in elastic constants of this small section are all determined from knowledge of the driving voltage on the transducer and of a voltage from a pickup electrode on the titanate.

Measurements at 17,500 cps by this technique show that internal friction is nearly constant for strains from 10^{-6} to 10^{-5} while it increases with larger strains. Up to strains of 2×10^{-4} to 2×10^{-3}, depending on the metal, this increase is reversible; but for still larger strains, the internal friction increases abruptly and the metal embrittles and fatigues in a very short time. At frequencies lower than that employed in these studies, the "critical" strains for fatigue are smaller.

The reversible increase of internal friction for intermediate strains is ascribed to the reversible production of loops of dislocations by the Frank-Read mechanism, and the distribution of dislocations computed from the measurements agrees with the observed distribution of



With this novel exponential horn attached to a barium titanate transducer, W. P. Mason of Bell Telephone Laboratories is gaining new insight into the atomic mechanism by which metals fatigue

etch pits. For large strains the dislocation loops are believed to expand irreversibly until they cut through restraining dislocations, thus producing jogs in each other and vacancies in the metal lattice. This "tangling up" of the dislocation loops results in embrittlement and the mobile vacancies diffuse together to produce fatigue cracks, their mobility and thus the rate at which fatigue occurs being increased by the applied stress. At very low temperatures, the stress must be increased until the activation energy is low, before vacancy diffusion can occur with the consequent production of fatigue cracks. At lower frequencies fatigue occurs at smaller strains because of the longer time during which diffusion can occur.

The conclusion derived from these studies is that any treatment of the metal which decreases the average length of the Frank-Read dislocation loops will increase the fatigue strength.

Copper Outlook

STEADY growth for years to come—that's the outlook for the copper industry, according to Theodore E. Veltfort, manager of the Copper & Brass Research Association. "Greater output from mines, sustained consumption, new uses for metals, a trend to more stable prices, and copper's inherent suitability for many applications, cause the copper industry to remain optimistic about the future," he said.

Markets for any material, particularly metals, Mr. Veltfort believes, are mainly determined by the interplay of two factors: (1) Economic conditions prevailing at the time a material is being considered and (2) properties and characteristics of the material. As they relate to copper, both factors portend a bright future.

World demand for copper is expected to continue strong. Overseas users have demonstrated the importance of copper by their willingness to purchase it at high prices during the past year. Yet, today the per capita consumption of copper abroad is only about one-seventh that of the United States. Therefore it is reasonable to forecast a steady increase in copper consumption throughout the world as other countries gradually improve their living standards by developing more complex machine technologies and mass-production concepts.

However, the copper supply pattern will become more favorable as greater capacity is realized from current expansion programs and newly developed free-world copper mines during the next three to five years. Literally hundreds of millions of dollars are being invested by copper producers to increase the annual supply of new copper available to users. The full effect of this broad-scale expansion will be felt year-by-year between now and 1960. As additional copper reaches the market each year, Mr. Veltfort said, a more stable relationship between supply and demand is likely to result.

Flowmeter Laboratory

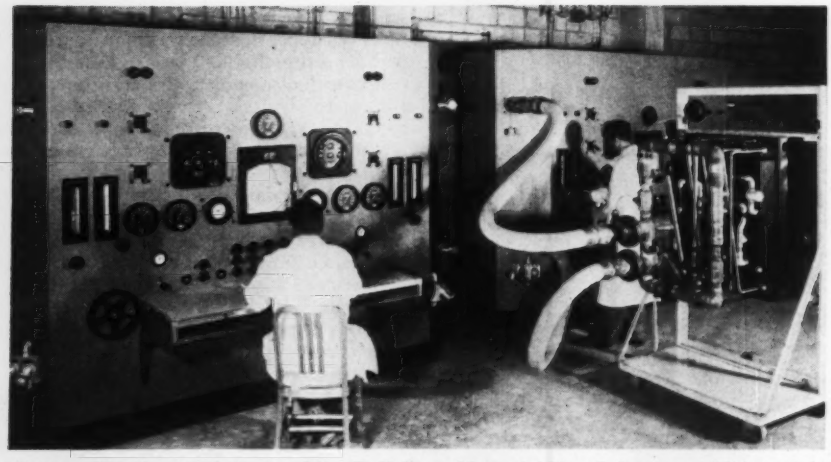
A NEW laboratory for the calibration of flowmeters is now in operation at Hatboro, Pa. It was built by Fischer & Porter Company, manufacturers of instruments for the measurement of pressure, temperature, level, density, viscosity, and other primary variables of fluids. The testing facility has been named the Allan P. Colburn Memorial Flow Laboratory in honor of one of the pioneers in fluids-engineering research.

The laboratory has been specifically designed for calibration of flowmeters measuring hazardous or volatile fluids (jet fuels) and is completely engineered for safety, accuracy, and flexibility. It presently consists of two calibration stands accurate to within ±0.1 per cent of absolute flow rate. They provide a range of from 100 to 125,000 lb per hr of liquid hydrocarbon. This laboratory is probably the only one commercially available in this country with this range. Future expansion of each stand to a maximum flow of 300,000 lb per hr is possible through the installation of additional pumping capacity. Temperature and flow control as well as automatic operation of the calibration cycle and electronic timing provide for top efficiency and maximum accuracy.

The facility is equipped to conduct calibrations on both a production and a research basis. The dual-calibration units utilize the standpipe-weigh-stand principle. Volumetric-displacement-type calibration stands, as well as facilities for the testing of density and viscosity-measuring instruments, are also available.

Each system contains a storage capacity of 2000 gal, a heat-exchange loop, pumping facilities, master control panel, and standpipes for fluid weighing. All tanks and pipes are underground, where practical, to provide maximum safety. Pipelines are completely color-coded for ease of identification. All electrical components in the hazardous areas are of explosionproof construction, and the pump house and main calibration room are continuously purged of hazardous vapors. Additional protection is provided by a carbon-dioxide spray and an automatic power shut-off system actuated by any rapid temperature rise within the area.

The laboratory, constructed by the lift-slab method, consists of two buildings occupying a restricted area separate from the main manufacturing plant. The main



Master calibration stands in new Allan P. Colburn Memorial Flow Laboratoy. Unit at right is calibrating a multistage flow test meter. Explosionproof manometers are on wall above stands.

building of the laboratory covers 2500 sq ft, of which a 1200-sq ft section is devoted to the control panels and calibration fixtures of volatile-fluids handling. A space of 400 sq ft of this building is retained for fluids-properties analysis, which tests density, viscosity, and yield-stress. The pump room covers 850 sq ft and houses all pumps and a portion of the heat-exchange system.

The facility is expected to add measurably to the quality of the company's flowmeters and to the plant capacity for completing them. It will find application primarily in the aircraft and related industries. Fuel economy is an important factor in the aviation industry, and as power plants have become more refined, the requirements for accurate flow measurement have become more demanding. The new laboratory assures high precision-instrument accuracy with promptness in meeting specifications.

Allan P. Colburn, for whom the laboratory is named, was world famous in the field of chemical engineering. Among Dr. Colburn's many research activities were basic studies on the theory of the variable-area flowmeter (rotameter). This work contributed much to the initial success and growth of the Fischer & Porter Company in the flow-measurement field. His theoretical studies, coupled with the development of precision-bore tubing and examinations of various float shapes by Fischer & Porter, enabled the rotameter to be manufactured and sold as a reliable industrial instrument. Dr. Colburn, who died in 1955, was chairman of the department of chemical engineering and assistant to the president at the University of Delaware.

A member of the ASME, Dr. Colburn served the Society in the Heat Transfer Division as follows: a member of the Technical Committee on Unfired Heat Transfer Equipment from 1944 to 1947, a member of the Special Advisory Committee on Heat Exchange Research from 1947 to the time of his death, a member of the Executive Committee from 1943 to 1948, and chairman of the Executive Committee and of the Division in 1948. He was a Clayton Lecturer to The Institution of Mechanical Engineers, Great Britain, in 1951. Dr. Colburn's lecture was titled, "Problems in Design and Research on Condensers of Vapors and Vapor Mixtures."

Dedication ceremonies of the laboratory were held July 31, 1956.

Cement Manufacturing Pilot Plant

A NEW pilot plant for testing, demonstrating, and developing untried raw materials and new techniques in cement making with the ACL traveling-grate process has been placed in operation by Allis-Chalmers Manufacturing Company at its Heat Processing Laboratory at Carrollville, Wis.

Essentially the ACL process consists of three parts: A pelletizing operation, a traveling grate for drying and partially burning the pellets, and a short kiln for final burning. Conventional wet and dry cement-manufacturing processes use only long kilns.

However, the ACL system takes up only a little more than half the space of conventional units. It features uniform pellets from raw material to finished clinker and the lowest fuel consumption and dust loss of any rotary kiln cement process known in the world today.

The ACL pilot plant plus the company's research-division facilities now enable Allis-Chalmer engineers to duplicate every stage of manufacturing cement, from the grinding of raw materials to the fine grinding of finished cement.

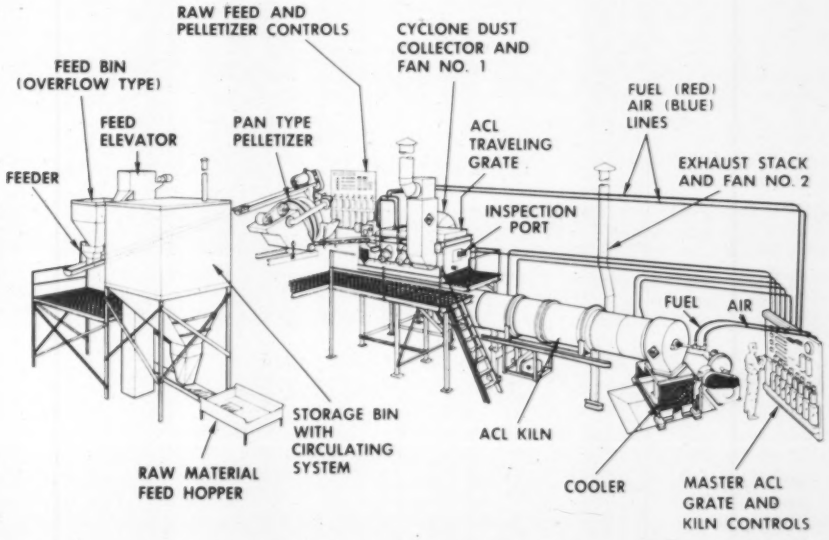
Pelletizing the raw mix locks in from start to finish the original blend of the various components, preventing segregation of the finely ground raw materials. Because the pellets remain uniform throughout the process, "flushing" in the kiln is minimized and more uniform burning conditions result. Pellet size is from $^1/_4$ to $^3/_4$ in.

Space requirements are reduced as much as 40 per cent in some cases. A full-scale ACL kiln will range from 120 to 175 ft long, with $10^1/_2$ to 13 ft ID. The ACL traveling grate will add a maximum of about 85 ft to the length, which is still well below modern conventional kilns, which range from 300 to 500 ft long, with 10 to 12 ft ID.

The grate enclosure is divided into two sections—the drying and preburning chambers. The pellets first enter the drying chamber where they are exposed to a downdraft flow of gases that enter at a temperature of 500 to 600 F. The gases dry the pellets uniformly and are exhausted to atmosphere at 200 to 250 F.

The pellets next enter the preburning chamber where they are exposed to a downdraft of hot kiln exit gases at 1700 to 1800 F. Here the pellets are partially calcined (25 to 35 per cent) and become hard before entering the feed end of the rotary kiln.

It is this double pass of the gases through the pellet



The ACL cement manufacturing system built by Allis-Chalmers at their Heat Processing Laboratory, Carrollville, Wis. With this pilot plant operating conditions of full-scale production can be predicted.

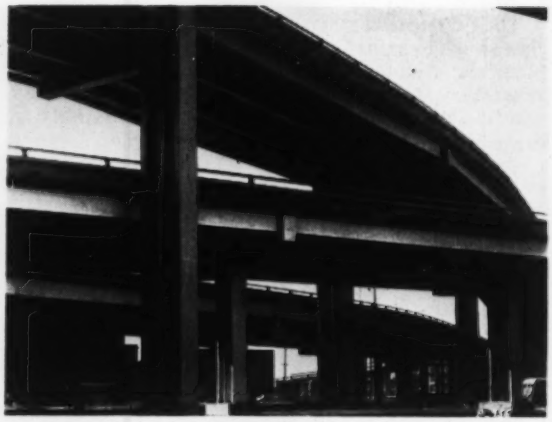
Pan-type pelletizer designed for the ACL cement manufacturing system. Note the uniformity of the pellets being discharged onto belt which carries them to ACL traveling grate. The proportions of the blended raw mix cannot vary anywhere in the system after they are locked in pellet form, thus preventing segregation of the finely ground raw material.

Checking burning-zone temperature of ACL pilot-plant kiln with optical pyrometer. Capacity of this pilot system is about 300–400 lb per hr. At far end of kiln is the ACL traveling grate. This pilot plant enables a cement manufacturer actually to produce clinker from his proposed raw materials at a nominal cost prior to building a commercial-sized plant.

bed that results in the extremely low dust loss without additional dust collectors. The second pass of gases occurs in the drying chamber where they come in intimate contact with moist pellets, which effectively remove the dust. Dust loss in the ACL system is less than one per cent per weight of feed. The ACL system, when followed by a rather modest electrostatic precipitator, will result in dust losses 6 to 7 times better than the requirements of the Los Angeles air-pollution code, which is the most stringent in the United States. In most cases, the ACL exit gases will be discharged to atmosphere cleaner than the surrounding air.

A commercial installation producing 4000 bbl per day will save from $10,000 to $30,000 per year just on the recovery of this dust. These figures are based on comparison with a conventional dry-process kiln, both with and without a mechanical cyclone collector following the kiln.

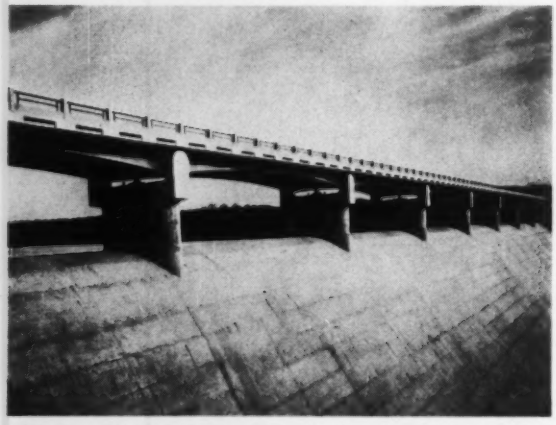
Fuel savings in the ACL system are even greater. In a commercial ACL system producing clinker at 600,000 Btu per bbl, as compared to 900,000 Btu per bbl and 1,000,000 Btu per bbl for well-operated dry and wet-process kilns, the savings will amount to between 10 and 20 cents per bbl, depending on type of fuel used. Again using a 4000-bbl per day plant, the fuel savings will total $120,000 and $250,000 per year as compared to a conventional kiln.



The 9th and 10th St. connections of the all-welded San Francisco Freeway Viaduct. This is the world's largest all-welded structure in terms of tonnage. Spans range up to 170 ft. The deck structure is made of beams and girders with shear connectors welded to the upper flanges to provide a composite construction. Transverse steel bents consisting of cap girders are supported by one, two, or three columns. Ramps of more than four lanes are supported by two and three-column bents; ramps of less than four lanes are supported by single-column "T" or cantilever bents. Savings in steel tonnage through welded design amounted to an estimated 20 per cent.

Welded Highway Bridges

THERE is an increasing trend toward the use of welded bridges in the country's rapidly expanding highway system, according to a recent survey of state bridge departments, made by The James F. Lincoln Arc Welding Foundation of Cleveland, Ohio. Of the 39 state bridge departments responding to the survey, 15, or 38 per cent, were using an increasing number of welded highway bridges. Another 13 states or a total of 72 per cent were using welding for certain details, such as coverplates, diaphragms, shoes, etc. Adoption of completely welded designs for more of their bridges was under consideration by many of these states.



Service Road over Hoover Dam Reservoir Project, city of Columbus, Ohio; eight 85-ft 3-in. spans of 100 per cent welded haunched plate girders with a 24-ft-wide roadway and two 1-ft-6 in. safety curbs

Reported savings in steel in typical bridges, resulting from welded design, ranged up to 20 per cent. If these savings were extended to the long-range road-building program that has been initiated by the Federal Government, enough steel could be saved to build a typical highway girder bridge approximately 800 miles long. The projected highway program of $51 billion will require an estimated 23 million tons of steel. Approximately half of this will go into bridges and overpasses. If welded design were able to save 20 per cent of this requirement, we would save, on bridges alone, more than three times as much steel as was used for all highway purposes in 1954.

Savings in cost that can be realized on welded bridges have also been reported to amount to 15 to 20 per cent.

Atomic Reactor Tank

PLANS to engineer and construct the largest pressure vessel of its type ever built have been announced by the New York Shipbuilding Corporation as subcontractor for the General Electric Company.

The pressure vessel—a welded-steel atomic reactor tank—will be built for the Commonwealth Edison Company's 180,000-kw Dresden nuclear-power station, near Chicago. General Electric will build the world's largest all-nuclear plant for Commonwealth and the eight members of the Nuclear Power Group, Inc.

The cylindrical vessel, of 12 ft 8 in. ID and an approximate height of 42 ft, will stand upright inside a steel sphere. The sphere will be 190 ft in diam. The vessel will have a $^3/_8$-in-thick carbon-steel welded assembly. When filled, it will hold approximately 278,000 lb of water. It will weigh approximately 400 tons and will be designed for an operating pressure of 1000 psia and an operating temperature of 544.6 F.

When completed the tank will be x-rayed and radiographed to guard against leaks, flaws, or weaknesses. It will be engineered to have an operating life of 40 yr, taking into account such factors as corrosion, erosion, material fatigue, and any change of properties due to constant exposure to radiation.

Low-Power Reactor

A NEW nuclear reactor, known as the Omega West Reactor, went into low-power operation recently at the Los Alamos Scientific Laboratory, operated by the University of California for the AEC.

A heterogeneous type reactor, it is similar to the Materials Testing Reactor at Arco, Idaho, but is intended for operation at a somewhat lower power. It is designed as a research tool, i.e., as a source of neutrons, and the emphasis is on facilities for doing irradiations in the available fluxes inside the reactor and for bringing collimated neutron beams, both slow and fast, out of the reactor. Opportunity will thus be provided for studies of a fundamental kind in nuclear physics and associated fields. Experimental ports penetrate the shield on five of the OWR's six faces, and a thermal column occupies the sixth face.

The reactive assembly, or "core," is immersed in water contained in a stainless-steel tank 8 ft in diameter and 25 ft high. The tank, in turn, is surrounded by "heavy" concrete 5 ft thick in the region of the core, and 3 ft thick in the upper half. The concrete is made from magnetite and iron punchings and has a density of 280 lb per cu ft. Top shielding for the assembly consists mainly of 17 ft of water between the top of the fuel elements and the top of the tank.

The actual location of the core is near the bottom of the stainless-steel tank. During operation the solid fuel elements containing U 235 are cooled by the water which also serves as a neutron reflector and moderator. There are 54 fuel positions, in the form of six rows of nine positions each. These can be used for fuel elements in various arrangements, sample holders, removable reflector pieces, etc. Control of the reactor is achieved by means of movable "poison" rods situated in the fuel assembly.

At first the reactor will be run at very low power while a series of experiments is carried out to investigate the detailed effects of the control rods and of various geometrical arrangements of the fuel elements. Following this, the power level will be raised to approximately 1,000 kw, and the reactor will be ready for experiments. After operating experience has been gained in the 1000-kw range, the power may be raised to about 5000 kw.

Tandem Accelerator

A NEW type of particle accelerator or "atom smasher" that will permit important advances to be made in fundamental physics research will be installed at Chalk River early in 1958, according to Atomic Energy of Canada, Limited. To be known as the Tandem Accelerator, the 10-million-volt machine will be constructed by High Voltage Engineering Corporation, Cambridge, Mass.

Chalk River physicists will be able to study in continuous detail the nuclear energy level of heavy elements which they know only in patches today. Until the tandem-style Van de Graaff accelerator became feasible, it was possible with the accelerator at Chalk River to study only certain of the light atomic nuclei. It will now be possible to carry out research programs on heavy nuclei with much greater accuracy and efficiency.

The new machine consists of two specially designed Van de Graaff generators placed end to end in a horizontal position, giving the accelerator an over-all length of 34 ft and a diameter of 8 ft. The 35-ton accelerator will be mounted on a rail in an L-shaped building, 150 ft long and 60 ft wide. The building now under construction at Chalk River is located against a hillside so that the ground on one side will act as the shielding against high-energy radiation. Thick concrete walls will shield other sides of the building. A separate building will house controls and services.

The beam of high-speed particles produced by the tandem accelerator will be focused and deflected in a series of powerful electromagnets into an experimental area 25 ft from the accelerator. The machine will be equipped with a unique switching magnet that will make it possible to shift the particle beam into any one of five directions, depending on the type under study.

The accelerator will incorporate a unique method of charged exchange whereby the electric charge of a nuclear particle is changed during acceleration to very high speed, permitting the same five-million-volt potential to impart the equivalent of a ten-million-volt beam to the particle.

Impact-Loading Bomb

A TESTING instrument—called a double-acting, rapid-impact loading bomb—that can give structural parts an atomic explosion treatment has been designed by Cornell University engineers.

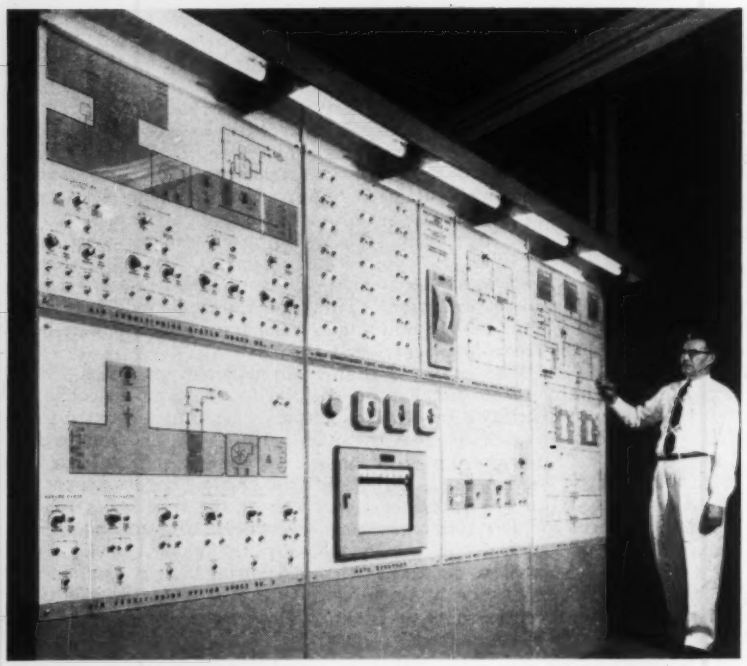
Using two charges in rapid succession, one below and one above its piston, the bomb can exert an impact that jumps from zero to 30,000 lb in 1/200 sec, maintain the load for 1/10 sec, and remove it in 1/200 sec.

In its final form, the instrument will offer a portable, low-cost way to find how full-scale structures react to high-intensity loading for a short period. The information will help in designing structures that can resist shocks of this kind. An oscilloscope, through strain gages connected to the piston rod, measures the force and high-speed movies run at regular speed report how the material reacts.

The bomb, a thick-walled aluminum cylinder about 10 in. × 6 in., was designed in Cornell's engineering mechanics and materials department. The project is sponsored by Johns Hopkins University.

The group has succeeded in synchronizing two bombs to explode within 1/1000 sec. With the problem of synchronization solved, any number of bombs can be hooked up to explode within that time. Such a series can be applied to horizontal structures like the beams or the wall of a building to simulate the shock wave of atomic blasts.

A single bomb has been used to test vertical wooden two-by-fours, the piston of the bomb placed at the base of a column firmly anchored at the top. Movies showed that some columns buckled "in the first mode"—with a single bow before breaking. By applying more force, the engineers induced buckling "in the second mode"—with a double-joined or S-shaped bow before breaking.



Advanced supervisory panel for an existing building—the Baltimore Gas and Electric Company office in Baltimore, Md.—was installed when building was air conditioned recently. Operator stands near colorgraphic diagram of the refrigeration system containing pilot lights to show equipment in operation, start-stop buttons, and a Tel-O-Set instrument for continuous checking of chilled-water temperature. A knob for changing water temperature and buttons for checking air temperatures in the primary air system are also provided on this panel. Other sections show the heating-cooling piping circuits in the building; a diagram of the primary air unit with temperature-reading buttons, start-stop switches for fans, and adjustment knobs for temperature set points; a bank of start-stop buttons for individual fan coil units; and panels showing and controlling air conditioning in two annexes.

Supervisory DataCenters . . .

. . . aid human supervision

More than 50 of America's most modern skyscrapers, shopping centers, hospitals, and other structures have, in the past year, applied advanced automation techniques to the problems of (1) cutting the cost of building operations, and (2) increasing the comfort of occupants.

In these structures air conditioning, heating, and ventilating are automatically controlled through master control panels known as Supervisory DataCenters. These installations represent the first stages of a trend which engineers of the Minneapolis-Honeywell Regulator Company recently predicted will lead to use of centralized data-control techniques in all major office buildings, apartments, schools, hospitals, and other commercial and public buildings.

Supervisory panels were first used in controlling industrial processes, such as in oil refineries, chemical plants, and wherever else there was need for precise measurement and regulation of a number of variable conditions. The processing industries are among today's leaders in industrial automation.

Efficient management of a building and human comfort, too, are compounded of complex factors. The Supervisory DataCenter automatically controls these factors. It also collects, displays, and records items of information essential to efficient human supervision of the system. From a single location one engineer can monitor and control comfort throughout the building.

Precision "reverse engraved" etching of colorgraphic Supervisory DataCenter panels is done in panel production factory. Here a worker adds a diagram representing a valve to a partially completed panel. Use of standard patterns helps speed etching process during panel fabrication. After diagram of system has been etched on plexiglas panel, plastic tubes of various colors are mounted to make identification easy.

World's strangest dial telephone is used to control operation of heating, ventilating, and air conditioning in one of the world's newest office buildings—the Bank of the Southwest Building in Houston. Seated before Supervisory DataCenter, the building engineer can read temperatures from 400 points in the building merely by dialing a code number. The number dialed shows in lights on his desk, the temperature reading appears on a scale. If adjustments are needed for maximum efficiency, he can make them without leaving his central control room.

Final connections are made in a junction box in back of one section of a Supervisory DataCenter panel. Panels are custom designed for each installation, produced by combination of latest automation techniques and skilled hand work by electrical and pneumatics experts. Panel is complete except for temperature-indicating instrument which will be mounted when unit is installed in building.

Supervisory DataCenter panel is fabricated in sections by Minneapolis-Honeywell engineers. Unit shown is part of advanced control system designed for Shannon Memorial Hospital in San Angelo, Tex. It is one of the first hospitals in the United States to use the advanced automation technique for controlling comfort and maintaining maximum efficiency of heating, ventilating, and air-conditioning operation.

European Survey

Engineering Progress in the British Isles and Western Europe

J. Foster Petree,[1] Mem. ASME, *European Correspondent*

Fifth World Power Conference

Among all the numerous international technical and scientific conferences that are now established features of engineering and science, the World Power Conference holds a unique position—as, indeed, its title shows to be no more than its due. Its inception in 1924, in connection with the British Empire Exhibition held at Wembley, near London, England, in that year, was principally the work of the late Daniel Nicol Dunlop (1868–1935), then the director and secretary of the British Electrical and Allied Manufacturers' Association, who had been previously for a number of years with the Westinghouse Electric Company at Pittsburgh, Pa., and subsequently sales manager of the British Westinghouse Company. The second World Power Conference was held in 1930 in Germany, at Berlin; the third at Washington, D. C., in 1936; and the fourth in London in 1950. The sixth is to be held in Australia in 1962. Between these so-called "plenary" Conferences there have been numerous others of a sectional character, held in various countries. One of these, which dealt mainly with the supply of energy for agriculture, small industries, public lighting, and railways, was held in Vienna in 1938, but since then Austria has been an occupied territory for 16 years, and so recently released from alien domination that the International Executive Council of the World Power Conference may reasonably have entertained some doubt whether the Austria of today had yet recovered sufficiently to undertake the organization and accommodation of a gathering of such magnitude. If, in fact, they did feel any such doubts, these must have been soon set at rest, for, while the machinery may have creaked a little at first, by the second day it had settled down to an even tempo and continued to run thereafter with a most creditable smoothness, considering that the 3000 or so members and ladies had come from more than 50 countries, and that the weather at times was by no means kind. The technical and formal proceedings in Vienna, which extended from June 16 to 23, were followed by a large number of study tours in which science and industry were agreeably mingled with the historical and the scenic; some of these continued until July 7, and the whole of them covered the country pretty thoroughly, some extending also to the frontier areas of Germany, Italy, and Yugoslavia.

The President of the Austrian Federal Republic (Dr. Theodor Körner) speaking at the inaugural meeting, in the Vienna State Opera House, of the Fifth World Power Conference, at which he declared the Conference open

Opening Proceedings

The official opening ceremonies took place on June 17 in the Vienna State Opera House, now completely restored after suffering severe damage during the war; a particularly appropriate meeting place, for it was in this building that the late Colonel R. E. B. Crompton made engineering history by equipping it with electric lighting on his five-wire system as far back as 1882.

[1] Correspondence with Mr. Petree should be addressed to 36 Mayfield Road, Sutton, Surrey, England.

Sir Harold Hartley, president of the Fifth World Power Conference, delivering his presidential address on June 17 in the Vienna State Opera House, at the opening ceremony of the Fifth WPC

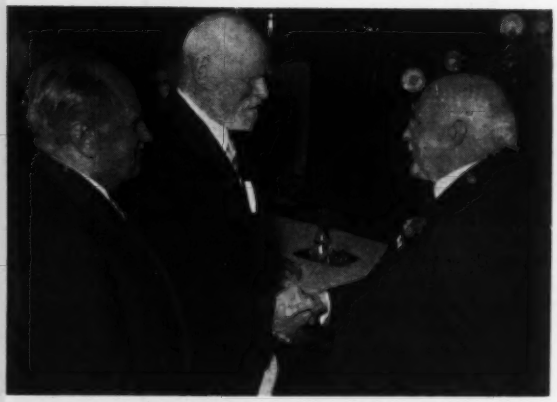
Spacious as the Opera House is, however, it was not possible to accommodate in it the whole of those who had assembled for the Conference, so that an overflow meeting had to be held in the Burgtheater; but a different program was arranged for them, no arrangements having been made to relay the speeches from the Opera House. This was a disappointment to many, but was considerably alleviated by the fairly full reports in German, English, and French which appeared next day in the Conference newspaper, *Weltkraft in Wien*, which was circulated daily during the run of the meetings. The president of the Austrian National Committee of the World Power Conference, Dipl.Ing. Franz Holzinger, took the chair at the inaugural meeting in the Opera House and opened the proceedings by expressing to the President of the Austrian Republic, Dr. Theodor Körner, the appreciation of the delegates and members of the honor of his presence. He then welcomed the various distinguished guests, who included members of the Federal government, and the ambassadors and ministers of foreign powers, and thanked Sir Harold Hartley (president of the World Power Conference), Sir Vincent de Ferranti, Hon. Mem. ASME, and Mr. C. H. Gray (chairman and secretary, respectively, of the International Council) for having supported the selection of Vienna as the meeting place. He welcomed also Prof. Erwin Schrödinger, the famous nuclear physicist and holder of the Nobel Prize for physics, who was to deliver a special lecture to the Conference at a later stage, and the representatives of the numerous international organizations who were present, emphasizing that the most efficient use of the world's natural resources required not only improved efficiency in processing, but also closer co-operation in the establishment of national, and especially international, grids for the distribution of the energy developed.

Sir Harold Hartley's Address

Sir Harold Hartley, as president of the Conference, then delivered his presidential address. After acknowledging in German the welcome extended to the delegates by the chairman and the honor conferred on the Conference by the presence of the President of the Republic, he proceeded to review the developments in world energy production and needs since the previous Conference. "It is a paradox of human destiny," he said, "that the rapidity of that advance has been quickened so much by the catastrophe of war and the threat of war that human nature has brought upon itself. But the advance has come and it has placed in the hands of mankind a new source of power and vast new possibilities of a closer partnership with Nature and of all that that implies. At the same time, the world's needs and the world's desires are increasing even faster. We are living in an age of rapid economic expansion—more rapid in industry, alas, than in agriculture, for food is the world's greatest need today with the perilous increase in world population. With these new developments have come new hopes and outlooks. They have made the menace of war so great as to render it almost unthinkable. They have made possible new levels of productivity, higher standards of living, greater comfort, better health, and more leisure. But they have faced mankind with the fact that the natural resources of the world are not unlimited and that we can no longer continue to squander them. Our closer knowledge of Nature's erratic distribution of her gifts among the countries of the world has brought home to us the inescapable community of interest of nations."

After touching upon the significance of last year's Conference at Geneva on The Peaceful Uses of Atomic Energy, and predicting that, by 1975, probably half of the world intake of energy would be distributed in the form of electricity, Sir Harold Hartley recalled how, more than 30 years ago, Daniel Nicol Dunlop "had the vision to foresee the need for a forum . . . for the discussion of problems of mutual interest in order that the energy policies of the future might be formulated on the broadest front." That, he said, was the purpose for which the World Power Conference was instituted, and it was a great tribute to Dunlop's imaginative conception that the wording of the original charter had remained practically unaltered. The value of the Conference depended on forecasting the energy problems of the future and the means of their solution, for "Life is dynamic and the slender thread on which it hangs is that ceaseless flow of energy."

Dr. Gail A. Hathaway, United States official delegate to the Fifth WPC and a vice-chairman of the International Executive Committee, addressing the opening meeting of the Conference



The President of the Austriao Federal Republic (Dr. Theodor Körner) (*center*) shakes hands with Sir Harold Hartley (*right*), president of the World Power Conference. At President Körner's side is Dipl. Ing. Franz Holzinger, chairman of the Austrian National Committee and a vice-chairman of the International Executive Council of the WPC. At the conclusion of the Conference, Sir Harold Hartley relinquished the office of president, which he had held since the Fourth WPC at London, England, in 1950, and was succeeded by Dipl. Ing. Holzinger, who will retain it until the end of the Sixth WPC, to be held in Australia in 1962.

Philosophy and World Power

Following Sir Harold Hartley's address, in which the proportion of pure philosophy, though evident, was not dominant, came a lecture in which it was, by Prof. Erwin Schrödinger on the subject, as he phrased it, of "the problem of consciousness, that is, the form the world takes in our thinking." He began by inviting his audience to forget for a while that they had gathered for a World Power Conference, but, by stages which need not be detailed, arrived at the interesting conclusion that, while wholly selfish egoism in man was on its way out and was being succeeded by "national egoism, or briefly nationalism"—which, he observed, "is also a vice"—the prevention of international war might be helped by the fact that egoism still retained its natural attraction. "A terrible new weapon of aggression threatens every one of us, prompting us to long for international relaxation for perfectly egoistic reasons. If we were bees, ants, or Spartan warriors, not knowing individual fear and considering cowardice the worst disgrace, we would continue to carry on with our wars. But fortunately we are human beings—and cowards."

The United Nations and World Energy

After their brief sojourn with Professor Schrödinger in the realms of higher thought, the audience was brought back to earth by Dr. H. L. Keenleyside, Director General of the Technical Assistance Administration of the United Nations, who reminded them that the United Nations Organization was founded for three main purposes: First, to repair the devastation caused by the war; second, to insure, if possible, "that war should not again bring humanity to the verge of universal disaster"; and, third, to face up to the fact that the basic problems of international relations could never be solved so long as two thirds of the people of the world continued to live, unnecessarily, in conditions of ignorance, poverty, and disease. No rational program of economic progress, he declared, and no sensible plan for expanded economic activity could be intelligently drafted without full recognition of the basic importance of the power component in the fabric of modern society. For that reason it was the earnest hope of the Secretary General of the United Nations Organization and of all those associated with him that the Fifth World Power Conference might contribute directly and effectively to the aims which UNO existed to promote.

Greetings From Contributing Nations

Dr. Keenleyside spoke for the United Nations, but it is customary on these occasions for the delegates of representative member nations of the Conference also to express the general sentiments. He was followed, therefore, by the official delegates of Germany (Dr. H. Kost), France (M. Robert Andre), the USSR (Mr. A. Pavlenko) and the United States (Dr. Gail A. Hathaway), in that order. Of necessity, since the topics and the circumstances were identical, they followed very similar lines, and an extract from the speech by Dr. Hathaway aptly summarizes the other three as well. After thanking their Austrian hosts for their welcome, he continued: "It certainly requires a great deal of courage to organize a plenary session of the World Power Conference and we are pleased that Austria has undertaken this task, notwithstanding the many other problems that prevail in the world today. There can be no doubt whatsoever of the great advantage of the exchange of views between the delegates participating in the Conference. Equally important is the opportunity for strengthening the bonds of friendship among colleagues of different nationalities. . . .We all recognize that in the field of world energy we stand before tremendous new and pioneering tasks, and it is singularly fitting that we should deliberate about these matters in this now-free capitol of one of the youngest members of the United Nations. That this fine city should also now have become the likely seat of the proposed International Atomic Energy Agency as a result of the support which my country and other countries are giving to the Austrian invitation is a further demonstration of the new role of this ancient capitol."

The Conference Opened

Thus, in an atmosphere of reiterated and obviously genuine goodwill, and with an interest continually resharpened by so many contrasting styles of oratory, the great audience arrived at the real point of the gathering, the formal opening of the Conference by the President of the Austrian Federal Republic, Dr. Theodor Körner. His address was brief, but cogent. "The subject of your discussions and consultations," he said, "forms one of the most important problems facing mankind today, since, within the space of a few generations, modern science has radically altered daily life in all civilized countries, creating and fulfilling new demands and opening up prospects and possibilities which seem to herald a second Industrial Revolution. All these achievements, however, depend on engineers having at their disposal those enormously and perma-

nently increasing quantities of energy that they need for the realization of their plans and inventions.

"Your choice of Vienna was perhaps prompted by the fact that Austria is a country fortunately endowed with rich and powerful sources of natural energy. The Second Republic has regarded it as one of its main tasks gradually to open up these resources, and has achieved results in this field which have been recognized throughout the world. It is due to this hard and determined work that today doubts no longer exist about Austria's power to exist independently. Austria has become the second biggest producer of crude oil in Europe and is the only country capable of making large-scale exports of electrical power . . . . The powers which this Conference proposes to explore and open up must not be misused for destruction, but harnessed only for universal joint progress. May your findings and recommendations be such that future generations praise the progressiveness of their forefathers, not curse a reckless curiosity which unleashed elements without mastering their force. It is with this wish that I declare the Fifth World Power Conference to be opened."

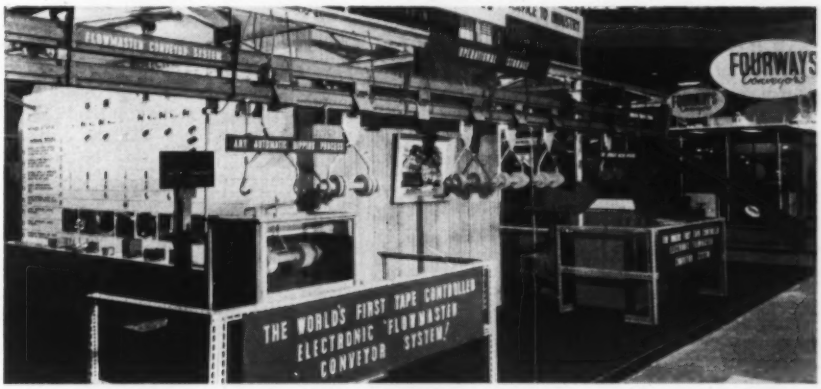
On the following day began the week of technical sessions in which the members had to receive and discuss some 260 papers, a task in which they were materially assisted by the issue of short-wave radio receivers, with which each individual could switch at will from the speakers to a simultaneous translation into English, French, or German, as he and the occasion might require. Incidentally, smoking in the conference halls was forbidden; but it did not take the would-be smokers long to discover that their little portable radios would receive almost equally well in the smokerooms adjoining, and even in the entrance hall on the lower floor. Whether this foreshadows the day when it will be possible to hold an international conference with all the *conférenciers* sitting comfortably at home remains to be seen. Before that day comes, however, it is to be hoped that science will have discovered some means whereby the individual may be able to scan 260 papers in sufficient detail to absorb their main points and appraise their relative value before the proceedings open. Meanwhile, without waiting for what science may do, could the organizers of the next World Power Conference look into the possibility of printing their advance copies on thin lightweight paper, for the benefit of the postage bill, the growing number of delegates who travel by air, and the still greater number of those who are not so young as they used to be, but who still have to hump their own baggage as often as not?

Tape-Controlled Conveyer

REFERENCE was made last month to an entertaining, if not especially useful, example of automation at the recent Mechanical Handling Exhibition in London, England, in which an overhead traveling crane, carrying an electromagnet, "played" automatically a game of chess with wooden chessmen 3 ft high, fitted on top with steel plates for lifting. The crane stand had its floor marked out as a chess board, on which were arranged wooden chessmen. The stand was spanned by an overhead electric crane with an electromagnet slung from its hook. Sponsored by the Vaughan Crane Company, of West Gorton, Manchester, England, in conjunction with Heenan & Froude, Ltd., Worcester, England, the crane automatically "played" a game of chess, picking up the pieces in turn with the magnet and placing them in accordance with the stored instructions.

Another and more practically useful demonstration of automation was provided in the same exhibition by the Materials Handling Division of Fisher & Ludlow, Ltd., of Bordesley Works, Birmingham, who showed what they claimed to be "The World's First Tape-Controlled Electronic 'Flowmaster' Conveyer System."

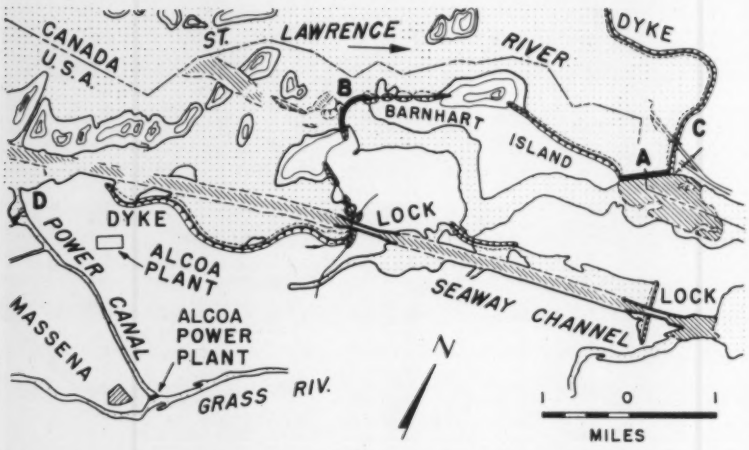
The tape control was similar to that described in the June issue, on page 557, a Creed teleprinter being used to perforate the tape. The carriers on the overhead conveyer, which made a complete circuit of the stand, transported wooden models representing short shafts which, in the course of their journey, were lowered into, and picked out of, cubicles corresponding to heat-treatment ovens, dipping tanks, etc. Some of the loads were painted red and some blue to distinguish them, and they could be checked, restarted, caused to by-pass one or another of the "ovens," switched to a storage line, and otherwise maneuvered by tapping out the requisite instruction on the teleprinter tape and feeding it into the control unit.



Electronically controlled conveyer at Mechanical Handling Exhibition, London, England, May 9–19, 1956

ASME Technical Digest

Substance in Brief of Papers Presented at ASME Meetings



Map of powerhouse area of the St. Lawrence Power Project, showing the powerhouse (A), Long Sault Dam (B), the canal closure structure (C), and the Massena intake (D)

Hydraulics

Mechanical Design Features of the St. Lawrence Power Project, by Dr. O. Holden and P. Pemberton-Pigott, The Hydro-Electric Power Commission of Ontario, Toronto, Can. 1956 Joint ASME-Engineering Institute of Canada Meeting paper No. **56—CAN-1** (multilithographed; available to Mar. 1, 1957).

THIS paper describes the design features of the items to be installed in the various structures of the St. Lawrence Power Project, now being constructed jointly by the Ontario Hydro and the Power Authority of the State of New York. A wide range of mechanical equipment is required for this project, and this paper gives particular attention to hydraulic gates and cranes. Reference is also made to the variations between some of the equipment in the Canadian and the American powerhouses.

Five main structures required for the generation of power and for maintaining the water levels for navigation are now being constructed in the International Rapids section of the St. Lawrence River, extending some 40 miles from Prescott to Cornwall, Ont. These are: the powerhouse (A), Long Sault Dam (B), the canal closure structure (C), the Massena intake (D), and Iroquois Dam. The first four structures are indicated in the accompanying map by letter designation.

The powerhouse (A) is a single structure combining both the Canadian and American powerhouses. Each powerhouse contains sixteen 75,000-hp, fixed-blade propeller turbines to which are directly connected 60,000-kva vertical generators.

While the equipment in both sections of the powerhouse is similar in capacity and function, there are variations between comparable items in order to meet the individual requirements of the two constructing entities. The exterior appearance of both sections of the powerhouse has been made identical, and the cranes and other service items have been made interchangeable.

The powerhouses are of the semi-outdoor type with an enclosed erection bay located at each shore. The spacing between machines is 80 ft, giving a total powerhouse length of 3120 ft and a plan area of $13\frac{1}{2}$ acres. In addition to the 32 generating units, there are six ice chute sluices located within the plants; two of these are at the center astride the international boundary, and the others pass under the erection bays located at each shore end. The generators are arrange with the top of the stator just a few feet below the powerhouse deck level, and removable covers are provided over the generators to give a weather-tight housing for each unit. Crane service is provided to the powerhouse by two 300-ton totally enclosed gantry cranes. These cranes can be moved over a unit to provide a weather-tight area over the machine during maintenance.

Each turbine is arranged with a three-conduit intake, and each individual water passage is provided with a 17-ft-wide headgate. The headgates are operated by individual hoists located in pockets below the level of the headwork deck. Removable covers are provided over the hoist pockets to allow the headgates to be removed for maintenance.

The Long Sault Dam (B) is the main spillway structure, and during construction it is the key item of the whole project, as it is from here that the river levels up to the town of Iroquois are controlled at their natural elevations during the various states of river diversion. The Long Sault Dam, along with the powerhouse, will maintain the forebay level. It is curved in plan although designed as a gravity section, and it consists fundamentally of a rollway surmounted by 30 spillway gates with a bulkhead gravity section at each end.

Each of the spillway gates is 50 ft wide by 30 ft high. Eighteen of these gates are provided with fixed towers and hoists, and the remaining 12 are operated by means of two gantry cranes. These 30 gates provide discharging capacity of several times the maximum river flow. The 18 gates associated with the fixed hoists are made in two sections, with semiautomatic couplings being provided between the sections. The upper section may be raised for the sluicing of ice, or the whole gate can be raised as one unit.

The canal closure structure (C) permits 14-ft navigation to continue on the Canadian side until the last stage of river closure. Thirty-four ports, each 16 ft by 19 ft high, are provided. During the final stage of closure, these ports handle the entire river flow. Fixed roller gates are provided to close off these ports as required for closure flow-control and for concreting operations. During the clo-

sure process, the thirteen 50-ft-wide diversion sluices are closed and concreted first, the river flow being progressively diverted to the closure ports. This permits 14-ft navigation to continue. The final operation is to close off the diversion ports.

The Massena intake (D) ensures the continuance of a water supply to the Massena power plant during construction and later for the supply of process water to the Alcoa plant. A detailed description of this structure is not given in the paper.

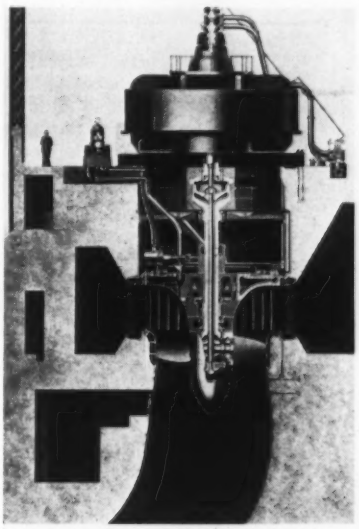
The Iroquois Dam permits control of the outflow from Lake Ontario. This dam consists of 32 sluices, each 50 ft wide, with the sill only a few feet above the rock bed of the river. At each end, bulkhead sections join up to the supporting contours. Each sluice is provided with a single-section fixed-wheel roller gate 48 ft high. A second gate slot is located upstream of the main checks for use with a set of stoplogs during maintenance work on the main gate. The gates are handled by 350-ton-capacity gantry cranes and are held in the raised position by "dogs" located at deck level.

The maximum head on the Iroquois Dam will occur during the construction period when the water level above the dam will be raised to assist dredging operations, while the water level below the dam will remain at its natural elevation. At this time, the differential head on the dam will be of the order of 24 ft, and this head has been instrumental in establishing the design criteria for both the structure and the gates.

The Kaplan Turbine in Canada, by G. Dugan Johnson, Mem. ASME, S. Morgan Smith Company, York, Pa. 1956 Joint ASME-Engineering Institute of Canada Meeting paper No. **56—CAN-2** (multilithographed; available to Mar. 1, 1957).

THE object of this paper is to encourage increased use of the Kaplan adjustable-blade propeller turbine in the continuing development of Canada's hydroelectric potential. To this end the physical arrangement and blade-operating mechanism are described, the history of its development is outlined with emphasis on laboratory research, and its outstanding performance characteristics are discussed briefly together with the attendant problems of cavitation, thrust, and runaway speed. The present use of Kaplan turbines for capacities up to 150,000 hp in the United States and heads up to 200 ft in Europe indicates the broad field for potential application in Canada.

A Kaplan turbine is a propeller wheel with angularly adjustable blades the inclination of which can be automatically controlled during operation. Physically it is exactly like a propeller turbine except for the adjustable feature of the runner blades with the resulting changes required in the main shaft plus the blade-control mechanism. The simultaneous adjustment of the blades to maintain optimum flow conditions through the runner for any position of the wicket gates results in exceptionally high part-load efficiencies and very flat efficiency-horsepower curves. In order to obtain the highest possible efficiencies under all conditions of load and head, the runner-



Sectional elevation of 42,500-hp Smith-Kaplan turbine

blade control system is interlocked with the wicket-gate governing mechanism, so that for every position of the gates the blades automatically assume their optimum position. Load changes actuate the gate mechanism through the governor in the usual way, and the mechanical motion of the gates is simultaneously transmitted to the blade-pitch control, causing the proper change in the inclination of the runner blades.

The specific speed of any hydraulic turbine may be defined as the best efficiency speed for a geometrically homologous unit capable of developing one horsepower under a head of one foot. Since it involves speed, output, and head, specific speed is really an index of the class to which any particular turbine belongs. In selecting the units for any installation, it is more economical to obtain the required unit output at the highest practicable speed, which permits the use of physically smaller turbines and generators with resulting savings in equipment cost and powerhouse construction.

However, the most suitable number, size, and type of units for a given development depend upon the available supply of water, its distribution throughout the year, and/or the amount of storage available, as well as the characteristics of the connected load. Within reasonable limits, larger machines favor lower capital and maintenance costs, but single-unit plants may not provide sufficient guarantee of continuous power supply or satisfactory part-load efficiencies. For a plant with a variable load, a number of small Francis or propeller wheels would be required to obtain good average operating efficiencies, which could justify the increased costs. In this connection, consideration should be given to the fact that the average part-load efficiencies of these types decrease as the specific speeds increase.

Two of the greatest assets of the Kaplan turbine are its very high specific speed and its high efficiencies over an extremely wide load range. Because of the resulting high average operating efficiencies the use of Kaplan runners instead of Francis or propeller wheels permits a considerable reduction in the number of units in any particular powerhouse without any reduction in the total annual power output from the available supply of water.

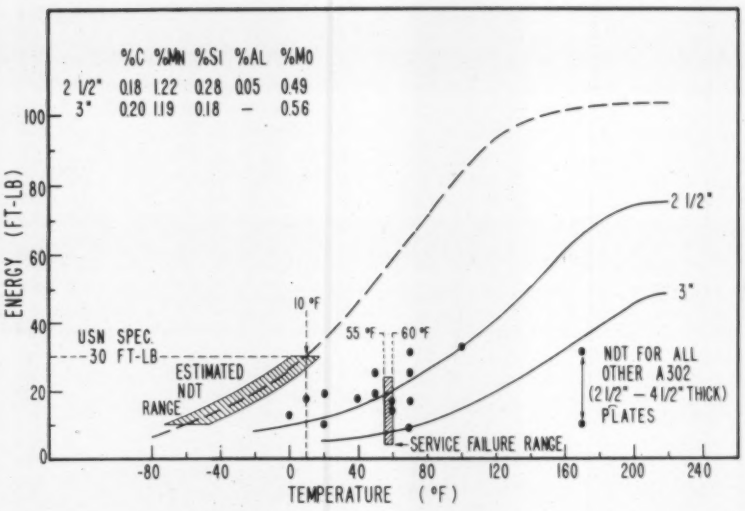
Another very valuable asset of the Kaplan turbine is its ability to provide high-power output under heads considerably below the normal or rated head. The capacities of Francis and propeller wheels are selected for the rated heads, and their outputs under load-head, high-tailwater conditions are limited. However, by increasing the pitch of the Kaplan runner blades well beyond that required for the normal rating, substantial "extra" full-gate capacity can be realized under low-head conditions without adversely affecting the high operating efficiencies under normal heads.

The highest-head Kaplan turbines operating in Canada are the two 104-in., five-bladed, 13,500-hp, 225-rpm, 75-ft-head units in the Tobique Narrows Plant of the New Brunswick Electric Power Commission. The highest-powered Kaplan turbine in Canada is the 21,600-hp, 128.6-rpm, 48-ft-head unit at the Bear's Paw Development of the Calgary Power Company in Alberta. It will shortly be eclipsed in capacity by the two 45,000-hp, 109.1-rpm, 57-ft-head

Kaplans now under construction for the Beechwood Development of the New Brunswick Electric Power Commission. Also worthy of note will be the six diagonal-flow, adjustable-blade pump-turbines of the Sir Adam Beck Niagara No. 2 project, rated to develop 45,500 hp at 92.3 rpm when operating as turbines under 83-ft head. As it becomes expedient to develop more and more Canadian hydro sites with heads of 200 ft or less, the use of Kaplan turbines should be considered.

Hydro power is not competitive with thermal power; the two are complementary. Co-ordination of run-of-river and storage hydro with interconnected thermal plants has become almost a science in itself. Effective integration of the various types is just as beneficial as the installation of substantial additional capacity. The specific roles of the different plants depend upon the character of the various installations as well as upon that of the connected load and will vary in accordance with changes in these conditions. At present, thermal plants usually carry block load at best economy and hydro plants follow load changes and take care of peak requirements.

The advent of nuclear-power plants as system components will probably intensify the use of hydro for regulating to suit changing load requirements and taking care of peak demands. Water power is not obsolete, especially in Canada; with free fuel and efficient designs, the future potential is almost unlimited, particularly for plants intended for regulating and peaking purposes. For peaking and load regulation over a wide range, the Kaplan turbine is in a class by itself; continued development and improvement of hydraulic and mechanical designs should make it economically attractive in Canada for many years to come.



Charpy V and drop-weight test results of heavy-wall-thickness A302 steels

Metals Engineering

Evaluation of the Significance of Charpy Tests for Quenched and Tempered Steels, by P. P. Puzak and W. S. Pellini, Naval Research Laboratory, Washington, D. C. 1956 ASME Metals Engineering-AWS Conference paper No. 56—MET-2 (multilithographed; available to Mar. 1, 1957).

CRACK-STARTER tests of various high-strength steels have been conducted to determine the critical fracture-transition temperatures at which welded structures, loaded in the presence of sharp, crack-like defects, may initiate or propagate brittle fractures. The test procedures establish three critical fracture-transition temperatures related to the specific loading conditions required to initiate and propagate brittle fractures. The temperature interval of change from the state of complete ductility (even under conditions of severe plastic deformation) to nil-ductility (such that brittle fracture initiation is possible upon reaching incipient yielding in the vicinity of crack defects) is shown to be approximately 100 F for all of the steels investigated. This interval was determined to be in the —200 to —100 F temperature range for the steels of highest notch ductility, and in the +100 to +200 F range for the steels of lowest notch ductility.

Correlation studies of Charpy V and keyhole-transition curves are presented. It is concluded that keyhole curves deviate greatly from Charpy V curves for materials of this type. The nil-ductility transition temperature in high-strength steels is generally related to the 20/30 ft-lb temperature of the Charpy V energy-transition curve. Fracture propagation is possible through elastic loaded material to temperatures corresponding to relatively high positions on the Charpy V transition curve; however, complete resistance to brittle fracture (shear tearing only) is obtained at temperatures related to the "upper shelf" of the curve. A discussion is presented relative to the use of the critical fracture-transition concept in design.

The sharp-crack defect was introduced by means of the brittle crack-starter weld method developed at the Naval Research Laboratory. Two test methods described as the drop-weight and explosion crack-starter tests were utilized to evaluate the fracture characteristics of the high-strength steels.

In the drop-weight test, loading is accomplished by dropping a weight which impacts at midspan of a $3^1/_2$-in. by 14-in. by plate-thickness specimen supported on a 12-in. span. A stop is placed under the specimen to limit the specimen deformation to minute amounts which may be described as "incipient yielding." Thus, this test determines the temperature below which yielding is not possible in the presence of a sharp crack, and fracture results.

In the explosion crack-starter test, a plate 14 in. by 14 in. by plate thickness is placed over a circular die and loaded by explosion of an offset charge. This test indicates the degree of "forcing" required to initiate fracture (at temperatures above the drop-weight test transition) by the amount of bulging developed prior to fracture. In addition, the explosion crack-starter test develops information concerning fracture propagation by establishing the temperatures at which brittle fractures propagate through the lightly loaded edge-regions (indicative of ability to propagate through elastic-load regions) or are restricted to the cold-worked (bulged) center regions. The utmost of resistance to fracture is also indicated in this test by the development only of short, ductile shear tears.

Existing boiler-code specifications limit the design for pressure vessels to

stress values of a maximum of one fourth ultimate strength (TS) of the material employed. Although such limitations approach a design factor of 2.5 based on yield strength (YS) for the carbon steels normally used, code requirements do not permit pressure-vessel design on the basis of such a factor. If permitted, such practices would afford the opportunity for the optimum utilization of high-strength steels possessing a higher TS/YS ratio than the carbon steels. Vessels of high-strength steels have been built, however, for specialized applications with design factors of 2.5 and, technically, not complying to the code. For reasons of economy and the greatest net return from the use of high-strength materials, the special pressure vessels have been constructed of ASTM-A302 material (80,000 psi minimum TS and 50,000 psi minimum YS).

During the past year, brittle-fracture failures of two such vessels constructed of heavy-wall-thickness A302 material have been experienced. The first of these brittle failures occurred during hydrostatic proof testing of the fabricated vessel at a temperature between 55 and 60 F. The second occurred at an identical temperature range in a partially fabricated vessel as the result of residual welding stresses developed during the welding of the manway reinforcement. Charpy V tests of steel taken from these two "service-failure" vessels corroborated the predictions made from drop-weight tests of these steels with reference to possible initiation of brittle fracture at temperatures corresponding to the 20 ft-lb Charpy V temperature. Drop-weight tests of these two failure steels indicated a nil-ductility transition (NDT) of 70 F for the first, and 100 F for the second, failed vessel.

For the development of optimum-strength properties in A302 material, a heat-treatment consisting of normalizing and tempering is required. Because of questions related to the heat-treatment of the steel involved in the initial failure, drop-weight tests were made of heavy-section A302 material after several different types of heat-treatments. A graphical summary of these tests is shown. The Charpy V curve and related drop-weight temperature position (heavy dot superimposed upon the V-curve) are shown for the 3-in-thick (initial failure under hydrostatic testing) and $2^1/_2$-in-thick (second failure due to residual stresses) A302 steels. In appropriate locations of Charpy V-energy and drop-weight temperature, the NDT results of the other steels are shown by the heavy dots, and the Charpy V curves for these steels have been eliminated for purposes of clarity. An average Charpy V energy of approximately 20 ft-lb and a range of 10 to 30 ft-lb appears to delineate the potential range of NDT characteristics for these A302 materials. That is, 30 ft-lb should be used as a minimum value for a safe fix for the NDT.

For Naval applications, such as air pressure vessels within interior holds of ships (minimum estimated service temperature of 40 F), new material is required to meet impact specifications of 30 ft-lb minimum at 10 F. This provides a safety factor of 30 F based on NDT and 40 F lowest operating temperature. The dashed curve represents the authors' estimation of the minimum acceptable heat under the new specification. Material of this nature (or better) should preclude the possibility of brittle-fracture initiation under normal service conditions as stated previously.

Production steels have a quality range; a range of 60 F in NDT is not unusual. Wartime ship-fracture steels investigated show at least such a spread (0 deg F for the best and 60 deg F for the worst). Examples of greater spreads have been encountered in other types. Thus, the data presented are considered to provide a guide as to the probable tolerance of the various steels with respect to specific temperatures and to various types of anticipated loadings. For certain applications where the steels may be of borderline quality for the intended service (A302, for example), rigid notch-ductility specifications may be necessary to achieve close control. On the other hand, for steels such as K-type, which are expected to have critical-fracture transitions far below the intended service temperatures, simplified procedures which determine whether proper heat-treatment was applied may be used for control or check. This, for example, would be the case for a Q and T steel of general —160-F NDT type which is to be used only at atmospheric temperatures.

Significance of Fatigue Data in Design of Pressure Vessels, by T. J. Dolan, Mem. ASME, University of Illinois, Urbana, Ill. 1956 ASME Metals Engineering-AWS Conference paper No. **56—MET-1** (multilithographed; available to Mar. 1, 1957).

In the hope of offering a discussion that may assist in developing a simple rational process for the design of vessels subjected to large numbers of cycles of repeated loading, this paper points out some of the difficulties inherent in the interpretation of fatigue data for inclusion in design procedures and indicates some of the reasons why careful consideration must be given to the possibilities of fatigue failure in pressure vessels.

In general, the types of surface defects, notches, and abruptness of changes in contour determine the localized stresses from which progressive fractures initiate if loading is repeated many times. Vessels intended for long life (thousands of load cycles) and which are subjected to large variations in stress (due to pressure variations or thermal fluctuations) should be designed for adequate fatigue resistance by eliminating excessive stress raisers and carefully controlling fabrication methods and operating procedures.

Stress raisers cannot be avoided entirely since localized stresses of high magnitude occur at (a) metallurgical notches due to segregation, inclusions, laminations, etc., in the metal; (b) mechanical notches caused by the changes of contour necessary in a member for its functional use; or (c) notches or other defects developed by corrosion pits, nicks, galling, etc., in fabrication or service. Progressive fractures develop from these discontinuities even though the nominal stresses calculated by the usual formulas may be well below the static elastic strength of the metal. A crack (such as a quench crack or that due to lack of root penetration in a weld) is a severe stress raiser and tends to be self-propagating during each repetition of loading.

Calculated stresses are only crude approximations of the real stresses existing in the crystalline structure of commercial metals. For fatigue conditions the behavior departs significantly from the idealized conditions (of homogeneous, elastic, isotropic metal) assumed for purposes of calculating stress. Damage accumulates during each cycle of loading and develops at localized regions of high stress within poorly oriented or weaker crystals until subsequent repetitions of loading finally cause visible cracks to grow, join, and spread. The progressive fracture is invariably nucleated by the presence of a stress raiser. Any abrupt step or recess in the surface (such as at a drum head, bracket, pipe connection, etc.) constitutes a stress raiser that may serve as the nucleus for a fatigue failure. It is not uncommon to have the fatigue strength cut in half by poor design details.

A vessel that is safe from the viewpoint of static load-design criteria (and which is not to be subjected to an excessively large number of cycles of loading) would have adequate resistance to fatigue fracture if all severe stress raisers were eliminated. Code values for allowable design stresses refer to the

nominal calculated membrane stresses in the shell and generally disregard the peak stresses in regions of local or gross discontinuities. For fatigue conditions these localized stresses at abrupt changes in section, such as a head junction or a reinforced opening, or due to misalignment, defects in construction, thermal gradients, etc., are the significant stresses that cannot readily be computed from the membrane stress.

The fatigue strength of a steel for a short cyclic life of about 1000 cycles may be as high as 90 per cent of the tensile strength. For larger numbers of cycles the strength falls off somewhat until the endurance limit is reached at about one million cycles of stress. For a rough design criterion, the relative values of allowable stress for different numbers of stress cycles could be estimated from curves of this type. The significant stress considered in the design should be the peak value occurring in the most severely stressed zone in the vessel. By proper attention to design details it is frequently possible to lower the range of peak stress developed, and a small decrease is accompanied by a large increase in fatigue life. Thus, if the maximum stresses are controlled by eliminating all severe stress raisers, adequate fatigue life is readily obtained.

The author emphasizes the difficulties of interpretation of laboratory fatigue data for quantitative design of full-sized structures. Limited-life fatigue testing can be highly misleading. The same metal tested in two different machines may exhibit different life to failure at the same general stress level. In some instances, two different metals have exhibited a crossing of their S-N curves; this means that entirely different conclusions would be drawn regarding the relative fatigue life of two steels when compared at high strain and again at low strain. Thus a comparison of two members made by testing at high overloads in order to shorten the duration of the test may not always be reliable in predicting their relative performance at the lower stresses expected in service.

For design purposes, laboratory test data cannot be used on a quantitative basis. In order to obtain quantitative data for design, it would be necessary to test large numbers of finished parts and to analyze the data in terms of the probability of a member exceeding a given life for a predicted loading history. This is seldom economically feasible for full-sized members such as pressure vessels. However, through intelligent use of fatigue data from studies that closely simulate the service conditions, by eliminating bad design details, and by employing better methods of stress analysis, it should be possible to avoid failures of most classes of pressure vessels even though significant increases in nominal design stresses are allowed.

If only a few thousand loading cycles are anticipated during the life, static design criteria are probably sufficient under present codes to eliminate possibilities of fatigue failure. However, if many thousands (or millions) of loading cycles are expected, the designer must pay careful attention to every detail of design, fabrication, and operation to assure freedom from fatigue cracks. Elimination of severe stress raisers in the design, adequate inspection to insure against improper or defective material or workmanship, and prevention of corrosive conditions or improper alterations while in service must all be primary considerations for satisfactory fatigue life.

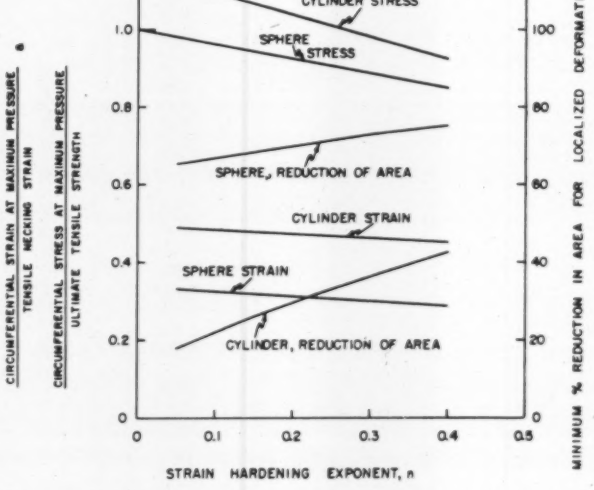
The Significance of the Tensile Test to Pressure-Vessel Design, by W. E. Cooper, Assoc. Mem. ASME, General Electric Company, Schenectady, N. Y. 1956 ASME Metals Engineering-AWS Conference paper No. 56—**MET-6** (multilithographed; available to Mar. 1, 1957).

THIS paper presents a discussion of the yield pressure, maximum pressure, strain at maximum pressure, and the localization of deformation at rupture in terms of the initial dimensions of cylindrical and spherical shells and the material properties of vessels made of ductile materials. In addition, design with brittle materials is discussed briefly, and the influence of strain concentrations upon differentiation between brittle and ductile materials is discussed.

From these discussions, it is concluded that, whereas initial yielding may be related to the properties usually reported from a tensile test, it is not possible to relate the maximum pressure which a cylindrical or spherical vessel can withstand directly to the ultimate tensile strength of the material from which it is constructed.

It is considered that yielding occurs when the distortion energy in the shell equals the distortion energy in the tensile specimen at its yield strength (von Mises criterion). In the usual vessel, this condition will first exist in the vicinity of structural discontinuities such as openings or head-to-shell junctions due to stress concentrations or discontinuity stresses. However, such yielding does not ordinarily contribute to the gross deformation of a vessel since adjoining elastic regions provide constraint. Hence only membrane yielding (yielding all the way across a section through the vessel) which can lead to gross deformations is considered.

If the pressure at which yielding occurs is designated by P_Y, the yield strength by S_Y*, the initial radius by R_0, and the initial thickness by t_0, the results derived are as follows



Numerical values of significant quantities for various values of the strain-hardening exponent n

Cylinder

$$P_Y = \frac{S_Y^*}{\sqrt{\frac{3}{4}\left(\frac{R_0}{t_0}\right)^2 + \frac{3}{2}\frac{R_0}{t_0} + 1}} \quad (1)$$

Sphere

$$P_Y = \frac{S_Y^*}{\sqrt{\frac{1}{4}\left(\frac{R_0}{t_0}\right)^2 \frac{R_0}{t_0} + 1}} \quad (1')$$

For large values of R_0/t_0 the equations simplify to
Cylinder

$$P_Y = \frac{2\, t_0\, S_Y^*}{\sqrt{3}\, R_0} \quad (2)$$

Sphere

$$P_Y = \frac{2\, t_0\, S_Y^*}{R_0} \quad (2')$$

Comparison of equations (1) and (2) shows that the R_0/t_0 ratio has little effect on the circumferential stress at yielding for a cylinder. In particular, this value is approximately 115 per cent of the yield strength. On the other hand, the circumferential stress at yielding for the sphere is significantly dependent upon the R_0/t_0 ratio. In particular, this stress is only 83 per cent of the yield strength for $R_0/t_0 = 10$ and increases gradually to 100 per cent of the yield strength for large values of R_0/t_0.

Equations are developed which relate the circumferential stress in the shell, when the maximum pressure is attained in terms of the initial radius and thickness, to a term which is dependent only upon the strain-hardening exponent and the ultimate tensile strength. The results are as follows

$$\frac{\text{Circumferential stress}}{\text{Ultimate tensile strength}} = \begin{cases} 2\,(3)^{-\frac{n+1}{2}} & \text{cylinder} \\ \dfrac{(2)^n}{3} & \text{sphere} \end{cases}$$

These quantities are plotted in the accompanying graph.

The results for the cylinder show that for $n < 0.26$ the circumferential stress based upon the initial dimensions exceeds the ultimate tensile strength when the maximum pressure is reached. The circumferential stress when the maximum pressure is reached decreases as n increases and is 93 per cent of the ultimate tensile strength when $n = 0.4$.

The results for the sphere show that the circumferential stress based upon the initial dimensions never exceeds the ultimate tensile strength when the maximum pressure is reached. In particular, the ratio has dropped to 0.85 when $n = 0.4$.

The results obtained show that the circumferential strain at the maximum pressure is considerably smaller than the strain at which necking occurs in a tensile test. In particular

$$\frac{\text{Circumferential strain}}{\text{Tensile necking strain}} = \begin{cases} \dfrac{e^{\frac{n}{2}} - 1}{e^n - 1} & \text{cylinder} \\ \dfrac{e^{\frac{n}{3}} - 1}{e^n - 1} & \text{sphere} \end{cases}$$

where e is the base of the natural logarithm (=2.71828). These quantities are plotted in the graph.

It is seen that the circumferential strain when the maximum pressure is reached is slightly less than 50 per cent of the strain to necking in a tensile test for the cylinder and approximately 30 per cent of this strain in the case of a sphere.

Up to the maximum value of the internal pressure the deformation of the vessel is uniform, neglecting edge effects. The question then arises as to whether the deformations remain general as they proceed to fracture or whether local deformation, such as that during necking of a tensile specimen, occurs.

The results derived show that considerable general deformation will occur after the maximum pressure is reached. The pressure within the vessel during this period will exceed that which the vessel can withstand statically with the result that the shell is accelerated outward. Failure will then occur with or without localized deformation, depending upon the available ductility, at strains considerably in excess of the strain when the maximum pressure is reached.

Indications are that local deformation will probably not occur (i.e., fracture will occur without necking) unless the per cent reduction of area in the tensile test is greater than approximately

$$100(1 - e^{-(n+0.15)}) \quad \text{cylinder}$$

$$100(1 - e^{-(n+1)}) \quad \text{sphere}$$

These quantities are plotted in the graph. The possible influence of the hydrostatic (mean) stress component upon this fracture ductility cannot be evaluated with present knowledge.

The major significance of this result is to indicate that considerably more energy is required to burst a shell of ductile material than would be concluded from the section discussing the strain at which the maximum pressure is reached.

Butt Welding Austenitic Stainless Steel to Ferritic Steel in Cylindrical Shapes, by J. E. Donahue, Mem. ASME, Westinghouse Electric Corporation, Philadelphia 13, Pa. 1956 ASME Metals Engineering-AWS Conference paper No. **56—MET-3** (multilithographed; available to Mar. 1, 1957).

The use of austenitic steels in the high-temperature parts of several modern central-station turbines necessitates a transition from austenitic to ferritic steels. Several methods of accomplishing this transition have been used in the industry with varying success and varying acceptance. This paper describes the design and the manufacturing techniques used by the author's company to produce certain transition pieces vital to the successful operation of a modern central-station steam turbine. These transition pieces are formed by a carefully controlled butt weld between austenitic and ferritic steels. Sizes vary from 1-in., Schedule-160 pipe to the equivalent of 16-in., Schedule-100 pipe.

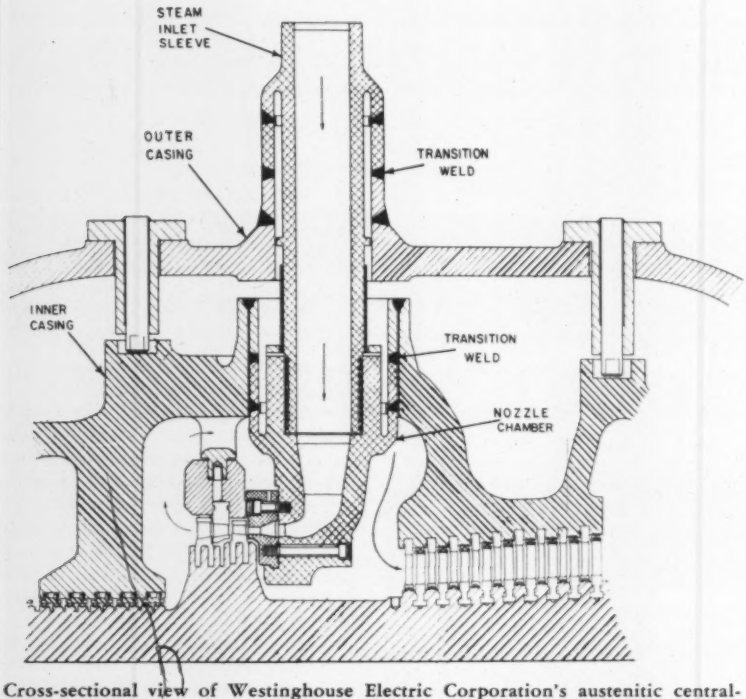
The basic construction used in the six austenitic turbines shipped by the author's company to date is shown in the accompanying cross-sectional diagram. The steam-inlet sleeves are austenitic, as are the separate nozzle chambers. The turbine outer casings as well as the inner casings are, however, ferritic steel. A section taken through the center line of the steam-inlet sleeves would reveal three inlet sleeves and three separate nozzle chambers in both the cover and the base of each turbine. Thus there are 12 transition welds in each turbine for a total of 72 transition welds in vital locations.

Each transition weld is designed and manufactured to meet exact requirements. Once these requirements are established, however, the care in the design and manufacture becomes almost routine. The basic approach used in the design of the transition welds has been to:

1 Make the transition weld as a butt weld in a separate spool piece (called a transition piece) using downhand welding and good shop-control techniques.

2 Make this spool piece of constant thickness, at least at the transition weld; that is, avoid physical shape discontinuities at the transition weld, if possible.

3 Select an annealing temperature for the transition weld that is compatible with the eventual operating conditions.



Cross-sectional view of Westinghouse Electric Corporation's austenitic central-station turbine

4 Provide extra wall thickness to allow for a finishing turn (OD) and a finishing bore (ID) after annealing of the transition piece. This removes any imperfections in the root of the weld as well as any undercuts, crowns and/or dendrites associated with the outside diameter of the weld. Thus, the transition weld is free of mechanical stress concentrations.

5 Make the usual x-ray, zyglo, etc., tests of the transition weld after machining of the transition piece.

6 Use sufficient length in the transition piece on each side of the transition weld. This is necessary to provide the flexibility needed to absorb the differential growth in diameter at the transition weld. It also assures that the subsequent ferritic-to-ferritic weldment and the subsequent austenitic-to-austenitic weldment at the ends of each transition piece are unaffected by the discontinuity at the transition weld. Thus the weldments at the ends of the transition piece, which may be in locations less than ideal, are not subjected to additional loading from the transition weld.

In essence, then, the design produces a transition weld free of mechanical stress-concentration factors, in a piece sufficiently long to provide adequate flexibility for absorbing the differential diameter growth. The length of the piece can be established using the theory for beam on an elastic foundation design. This theory demonstrates that the longitudinal bending stress, the average tangential (circumferential) stress, and the direct shear stress caused by the differential expansion at the transition weld dampen out in a wave-form pattern along the longitudinal axis of the pipe. Once the diameter and wall thickness needed to meet the design requirements for the ferritic half are established, the austenitic half arbitrarily can be made the same thickness. The length of the transition piece on each side of the transition weld is determined graphically.

Long-time exposure at actual operating conditions, to date, has shown no detrimental effects on properly made and properly applied austenitic-ferritic butt welds. These operating conditions include pressure, temperature, and external loadings, such as the steam-inlet piping reactions and the nozzle-chamber reactions which are transmitted through transition welds to the outer turbine casing and the inner turbine casing, respectively. If the procedure outlined in the paper is followed, it would appear that direct austenitic-to-ferritic butt welds in today's conventional materials can be made in pipe shapes with assurance of complete operating success.

Time-Temperature Effect on Properties of Weld Heat-Affected Zone in Type-347 Stainless Steel, by E. F. Nippes, Rensselaer Polytechnic Institute, Troy, N. Y., B. Schaaf, Westinghouse Electric Corporation, Philadelphia, Pa., and W. L. Fleischmann, Mem. ASME, and R. L. Mehan, General Electric Company, Schenectady, N. Y. 1956 ASME Metals Engineering-AWS Conference paper No. 56—MET-5 (multilithographed; available to Mar. 1, 1957).

COLUMBIUM stabilized 18 chromium-8 nickel-1 columbium (Type 347) is widely used in the power and atomic-power industries. Both industries must insist that equipment in their plants operate with utmost reliability; adverse experiences are usually the beginning of intensive investigations into the causes of difficulties. Though in general Type-347 stainless steel has behaved well, reports show that about one half of the fabricators have noticed base-metal cracking in the weld heat-affected zone. This type of failure also has been observed after extended service.

To obtain an understanding of the metallurgical changes occurring in the weld heat-affected zone during welding and subsequently in service, an investigation was conducted in the metallurgical department of Rensselaer Polytechnic Institute. The initial report covered the establishment of the heating and cooling cycles occurring in metal-arc welding of a $1^1/_2$-in-thick plate. Some data were presented which spotted the potentially troublesome area in the region heated to above 2400 F.

The work which is presented in this paper concentrated on the behavior of samples heated in synthetic welding cycles to a peak temperature of 2450 F. The brief duration of that temperature was sufficient to cause concomitant grain growth and solution of the carbide phase. This condition simulated those existing in that region of actual welds where troubles were experienced. The general type of information which this work was intended to provide was to establish the time-temperature behavior of the high-temperature metallurgical structure (2450 F) established in the welding cycle.

The synthetic weld heat-affected zone was produced on the RPI time-temperature controller. The time-temperature cycle used here for the production of the 2450-F region of the weld heat-affected zone was the same as used in the preceding investigation.

The selection of the 2450-F temperature was a compromise between reproducibility and peak temperature. Though samples representing the 2500-F peak-temperature region would perhaps

show more striking results, the reproducibility of samples at that high temperature was impossible to obtain because the temperature control did not respond fast enough to control the heat input within one cps. One additional pulse caused incipient melting and so ruined the sample. The simulated weld heat-affected-zone test samples were subjected to a variety of sensitizing treatments to detect any metallurgical phase changes and resultant mechanical and corrosion property changes.

Tensile-test specimens were machined from round, synthetically welded specimens. The specimens were 0.250 in. in diam with a 1.0-in. gage length. They were machined so that the peak thermal-cycle band was in the center of the gage length. Impact specimens were standard Charpy V-notch specimens machined from square, synthetically welded samples. The peak thermal-cycle band was at the center of the specimen.

Stress-rupture specimens were 0.357 in. in diam with a 1.06-in. gage length. The specimen had a 60-deg notch 0.052 in. deep with a 0.005-in. radius at the base. The peak thermal-cycle band was at the base of the notch. The samples used for the metallographic study and the boiling 65 per cent HNO_3 corrosion test were thin disks 0.385 in. in diam and 0.10 in. thick machined from the center of the 0.50-in-diam, synthetically welded specimens.

The as-received material was fine-grained with the carbide phase well dispersed in dot form except for a limited number of larger inclusions. Considerable grain growth was produced in the material by the synthetic weld heat-treatment to 2450 F. The dot carbides originally present completely disappeared as a result of this treatment. The larger inclusions appeared undisturbed.

Sensitization treatments at lower temperatures and shorter times produced a fine continuous precipitate at the grain boundaries. Higher temperatures and longer times caused this precipitate to agglomerate and lose its continuity along the grain boundaries.

The disk-type corrosion specimens were subjected to attack by boiling 65 per cent nitric acid. Each specimen was exposed to the acid for five 48-hr periods. Fresh solutions were used for each period. The weight loss due to corrosion was converted to in-per-month penetration in accordance with the ASTM standard conversion.

The weld heat-affected zone in the as-welded condition was not attacked by the boiling nitric acid. This is in agreement with the previous report in this investigation where it was shown that the corrosion rate is independent of the peak heat-treating temperature.

After sensitization in the carbide-precipitation range (800 F–1500 F) the corrosion rate first increases rapidly with increasing parameter, and then decreases. The rapid corrosion rate is associated with those structures showing a continuous carbide network at the grain boundaries, and the slower rates with agglomerated carbides.

For the heats of Type-347 stainless steel used and the heat-treatment employed, the following conclusions are reached: (1) High-temperature heat-treatments of Type-347 weld heat-affected zones do not impair the mechanical properties of this region. This does not preclude the possibility of liquation causing damage to the structure; and (2) Corrosion in 65 per cent boiling nitric acid of weld heat-affected zones is time-temperature dependent. For the particular heats studied, a high-nickel 347 stainless steel is more susceptible to intergranular corrosion than a low-nickel steel. It would seem that the presence of ferrite in the low-nickel steels provides precipitation sites for chromium carbides and reduces the severity of the grain-boundary effect.

Considerations Affecting Future Pressure-Vessel Codes, by J. J. Murphy, Mem. ASME, C. R. Soderberg, Jr., Assoc. Mem. ASME, and D. B. Rossheim, Mem. ASME, The M. W. Kellogg Company, New York, N. Y. 1956 ASME Metals Engineering-AWS Conference paper No. **56—MET-4** (multilithographed; available to Mar. 1, 1957).

TENTATIVE basic principles are indicated in this paper for revision of the ASME Code for Unfired Pressure Vessels to a broader base to suit the wide variations in service and economic demands. Major basic principles are suggested for a modified code which would emphasize balanced requirements to achieve maximum economic safety and also provide a broad base for effective utilization of new materials and designs toward satisfying the demands of widening industrial needs. A discussion of design, fabrication, selection of vessel classes, stress criteria, safety factors, materials and metallurgy, and inspection is given in detail, and proposed modifications are presented in summary form supported by a tabular comparison.

The ASME pressure-vessel codes do not provide complete guidance as to minimum requirements for other than mild or average service and simple design, although the detail-design requirements have been necessarily expanded to a considerable degree.

If the code is modified to recognize that the best interests of safe construction will be served by defining the extent and general methods of analyses, with explicit limits for secondary localized stresses, the code need not assume gigantic proportions.

Certain design formulas are of basic significance, such as those for the shell and head thickness, and these would continue in the main body of the code with the results entered on the vessel data sheets. However, the many special details, such as flanges, intersections, lugs, skirts, and similar details of fabrication and materials, would be treated in the appendixes where frequently used formulas could be cited for assistance in handling less common problems. All calculations would follow the basic criteria stipulated in the body of the code and could be made by competent vessel designers without reference to other developments or formulas. With this approach, average vessels would be designed as readily as they are at present; more complex vessels would require competent knowledge which they do even now, but could then be accomplished without numerous arbitrary restrictions. Many requests for code interpretations and revisions might be avoided by an approach which recognizes principles and avoids arbitrary detail.

Service hazards in the operation of pressure vessels are grouped as: (a) overpressure, (b) overtemperature, and (c) other effects. At present, only the first of these is formally recognized, and the second is covered for fired steam boilers only by special code sections. Other effects include explosions, resonance (flow and structural), deterioration by nuclear-fission products, dynamic effects of the structure (including acceleration effects), heat transfer, and temperature change—many of which are listed for design consideration in the code, but without assistance as to design methods or criteria.

Two alternate philosophies of high-temperature vessel design are offered: (1) Continue present high-temperature stress criteria, but with construction requirements of vessel class C for the elimination of present weak areas, and (2) advance the limits for principal stress in recognition of the greatly reduced local stresses of vessel-class-C requirements. An increase of 33 per cent to correspond to that proposed for temperatures below the creep range would accelerate creep for carbon steel and most ferritic materials roughly to one per cent in 24,000 hr, or 4.2 per cent in 100,000 hr.

Two types of stresses are distinguished:

(1) direct, which is constant throughout the thickness and (2) bending, which varies from positive to negative across the thickness. Stresses are further classified as: (1) primary, which are the direct or bending stresses generated by the imposed loading and which are necessary to satisfy the simple laws of equilibrium between forces external to the shell and stresses within the shell, and (2) secondary, which are by definition local stresses which exist only in a small portion of the vessel. Direct or bending stresses which exist in a length less than $3\sqrt{Rt}$ are secondary stresses.

These stresses can be caused by two types of loading—external forces or strain loadings. They are caused by the former if the loading is independent of the deformation and thus capable of causing complete fracture. They are the result of strain loading if the load and strain are interdependent, and plastic strains can relieve the loads.

Essentially the present ASME Code for Unfired Pressure Vessels considers only primary direct and bending stresses, and hence is suited only for substantially static (noncyclic) service. This approach is continued by the destructive type of code proof tests. For other types of proof tests a part which previously has been cold-worked by a preliminary application of twice the design pressure is only required to be free of yielding in the formal test. Thus no check of initial yielding is obtained by this test. Brittle coatings and destruction tests do not satisfactorily indicate local areas of high stress but, rather, react more nearly to average stresses. The requirement for strain-gage measurements in most highly stressed zones, in the alternate tests which may be used, seems to the authors out of place with the general code approach. The destruction test often has shown that local areas of high stress undergo only limited strain and can develop the full static-pressure rating of the basic structure, allowing the failure to occur elsewhere.

In keeping with the objective of more accurately assessing performance, it is recommended that the effective stress be evaluated by the shear-strain energy theory sometimes called the Mises-Henchy criterion, at least for class C vessels. One of the main advantages of the criterion is that it permits the calculation of two functions called the intensity of stress and intensity of strain in a two or three-dimensional state of stress. The intensity of stress and strain are directly related to quantities measured on a simple tension test. For heavy thickness and/or high temperatures, stress formulas based on the stress distribution which prevails in the plastic state or understeady-state creep conditions can be utilized for temperatures below and within the creep range, respectively. From a fatigue-resistance standpoint, it is the strain range per cycle at the critical fiber which determines performance. A measure of this strain range is most conveniently obtained from elastic stress analysis.

Gas Turbine Power

33,000 Hr on Marine Gas Turbines in Naval Service, by W. M. M. Fowden, Jr., Mem. ASME, and J. W. Sawyer, Mem. ASME, Bureau of Ships, Department of the Navy, Washington, D. C. 1956 ASME Gas Turbine Power Conference paper No. **56—GTP-7** (multilithographed; available to Feb. 1, 1957).

BASED on over 33,000 hr of operating experience of six types of marine gas turbines in naval vessels, this paper describes the applications of these prime movers and discusses their performance in an effort to demonstrate the reliability, long-range economy, ease of operation, and quick replacement of these gas turbines.

The models presently in use on U. S. Naval vessels are as follows: Solar T-520, Boeing 502-6, Boeing 502-8C, Boeing 502-2, Solar T-45, and Boeing 502-6M. Of these, the most widely used model is the Boeing 502-6, with 31,231 hr of operating experience.

Naval applications of marine gas turbines have increased rapidly during the past few years. Installations of gas-turbine engines which have been made and are now in use include emergency generator, propulsion, and auxiliary generator. At the present time a total of 55 vessels are in operation with gas-turbine engines installed. These include a destroyer, landing craft, and a number of minesweep vessels. The number of engines installed include 200 individual units. The total installed horsepower as of Nov. 1, 1955, was 32,564. Operating time on the installed engines up to Nov. 1, 1955, was 33,327 hr. The majority of the operating hours was built up by engines driving auxiliary generators.

The Boeing 502-6 engine is used to power the auxiliary generator sets on the MSB-5 class vessels. Forty-six of these vessels have been equipped with this engine and a total of 184 units have been installed. The engine is unique in that it is the first marine gas-turbine engine to be built in production quantities. A number of marine gas-turbine engines of other types have been built and installed. However, none of these has been built in quantity production.

The basic engine is rated as a 160-hp unit. These engines are used in pairs to drive the auxiliary generator. Two generator sets are installed on each vessel. Each engine feeds into a combining reduction gear which in turn drives the generator at a normal speed of 2000 rpm. The input pinion from each of the gas turbines is attached to a flexible overrunning clutch. The compressor on this engine is a single-stage centrifugal type with the normal pressure ratio of 3:1, with 3.5 lb per sec air-mass flow. The first-stage turbine is directly connected to the compressor to form the gas-producer section. There are two combustion chambers connected by a cross-fire tube. The first-stage rotor turns at 36,500 rpm normal maximum and the second-stage turbine is a free-wheeling unit which turns at 23,725 rpm normal. The engine has a built-in reduction gear with a ratio of 8.62:1.

An interesting application of the Boeing 502-6 engine is its use in Arctic operations for de-icing exposed equipment and structures on ships. Ice formation on equipment and deck structures can be serious, and the hot exhaust gases from the gas turbine have been found effective in recent tests for removing the ice.

The gas turbine has demonstrated its reliability in the marine and naval fields. Experience has been obtained by the Navy on the marine gas turbines and a number of new construction projects are under way that will use gas turbines as propulsion and auxiliary drive.

Rotary Regenerator for Gas Turbines, by J. C. Miles, N. A. Parker, Mem. ASME, and R. L. Smoot, University of Illinois, Urbana, Ill. 1956 ASME Gas Turbine Power Conference paper No. **56—GTP-9** (multilithographed; available to Feb. 1, 1957).

TEST performance of a rotary regenerator comprising the experimental evaluation of three lengths of flame-trap-type matrixes is presented. Design parameters based on the experimental results are given. A compact structural design of a rotary regenerator is illustrated along with a configuration for a proposed application to small turbines. A seal design is suggested, and the problem of matrix fouling is discussed.

For a regenerated cycle of high effectiveness, the specific fuel flow is approximately halved; therefore the fuel-air ratio is sufficiently low that the effect of fuel or combustion products in the air

stream can be neglected. By dealing only with the properties of air it is possible to evaluate closely the cycle energy-input, work-output, work ratio, and component efficiencies. Such an assumption permits many simplifying relations, particularly if the mean air temperature and pressure and, consequently, all other physical properties of the air in the regenerator are assumed equal respectively to those of the gas. This assumption is sufficiently close to establish design parameters for low-pressure, high-effectiveness wind-tunnel data. Such an assumption would be crude for unsteady-state analysis.

This paper was abstracted from a report on research, the object of which was "to design, build, and test a regenerator most suitable for portable gas-turbine power packages." The ultimate in such a regenerator design would provide: (1) perfect heat transfer or effectiveness, (2) no flow resistance or pressure drop, (3) no leakage or carry-over losses, (4) no fouling from combustion deposits, and (5) a mechanically perfect structure of minimum size. The results obtained from the research indicate good possibilities for constructing a practical high-efficiency regenerator.

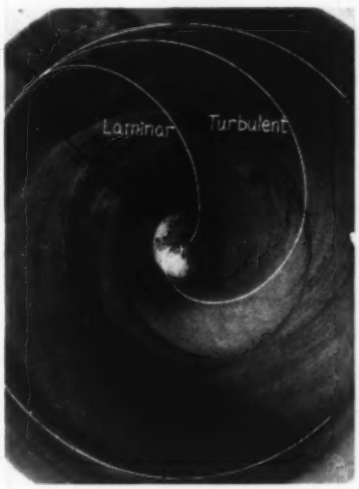
Applied Mechanics

The Boundary Layer Inside a Conical Surface Due to Swirl, by H. E. Weber, Shell Development Company, Emeryville, Calif. 1956 ASME National Applied Mechanics Conference paper No. **56—APM-31** (in type; to be published in the *Journal of Applied Mechanics;* available to April 1, 1957).

An analysis of the axially symmetric boundary layer on the inside of a conical surface due to swirl flow about the conical axis is presented. The momentum integrals of the boundary layer are derived, and both the laminar and turbulent boundary-layer solutions are obtained numerically. A comparison between theory and experiment is made by using the particle paths on the conical surface of a cyclone dust separator.

In a cyclone dust separator the tangential-velocity components are much greater than the axial and radial-velocity components except in a region near the cyclone axis and in the boundary layers near the walls. Therefore, as a first approximation, the flow outside of the wall boundary layer on the conical surface of the cyclone may be considered as a two-dimensional vortex; i.e., the component of velocity parallel to the wall in a meridian plane may be assumed zero. In addition, it may be assumed that the vortex in the free stream is a potential vortex about the axis of the cone and outside of central fluid core and that the potential vortex exists outside of the wall boundary layer over the entire axial depth of the conical surface.

The free-stream vortex creates a pressure gradient with pressure decreasing radially inward. This pressure gradient has a component parallel to the cone wall. In the free stream the pressure gradient is balanced by the radial acceleration of the fluid, but in the boundary layer the pressure gradient causes fluid which is retarded by the wall and has a smaller radial acceleration to acquire a component of velocity in a meridian plane. However, the total velocity



Lampblack streaks on conical surface of a cyclone dust separator compared with theoretical streaks

is zero at the wall. In the free stream the component of velocity in a meridian plane is zero by the assumed flow conditions. Therefore this component of velocity is zero at the surface of the boundary layer and at the wall of the cone and attains a maximum value somewhere in the boundary layer.

Finally, the customary boundary-layer assumptions are made. The velocity normal to the wall is assumed negligible as compared with the velocity parallel to the wall. The variations in pressure through the boundary layer in the direction normal to the wall are assumed negligible as compared with these variations in the direction parallel to the wall. In addition, the boundary-layer thickness is assumed to be small compared with the radius of the cone. In this analysis the momentum integrals of the boundary layer are employed, and both laminar and turbulent boundary-layer solutions are obtained.

Three-Dimensional and Shell-Theory Analysis of Axially Symmetric Motions of Cylinders, by G. Herrmann, Mem. ASME, and I. Mirsky, Columbia University, New York, N. Y. 1956 ASME National Applied Mechanics Conference paper No. **56—APM-32** (in type; to be published in the *Journal of Applied Mechanics;* available to April 1, 1957).

The frequency (or phase velocity) of axially symmetric free vibrations in an elastic, isotropic, circular cylinder of medium thickness is studied on the basis of the three-dimensional linear theory of elasticity and several different shell theories. To be in good agreement with the solution of the three-dimensional equations for short wave lengths, an approximate theory has to include the influence of rotatory inertia and transverse shear deformation, for example in a manner similar to Mindlin's plate theory. A shell theory of this (Timoshenko) type is deduced from the three-dimensional elasticity theory.

From a comparison of phase velocities it appears that, to a good approximation, membrane and curvature effects on one hand, and, on the other hand, flexural, rotatory-inertia, and shear-deformation effects are mutually exclusive in two ranges of wave lengths, separated by a "transition" wave length. Thus, in the full range of wave lengths, the associated lowest phase velocities may be determined on the basis of the membrane shell theory (for wave lengths larger than the transition wave length) and on the basis of Mindlin's plate theory (for wave lengths smaller than the transition wave length).

The Sector-Shaped Pad, by C. F. Kettleborough, University of Melbourne, Melbourne, Australia. 1956 ASME National Applied Mechanics Conference paper No. **56—APM-22** (in type; to be published in the *Journal of Applied Mechanics;* available to April 1, 1957).

Boegli's simplifying assumptions for the solution of the rectangular pad have been applied to the sector-shaped pad and extended to the case of varying viscosity. Two assumptions were made in Boegli's analysis: (1) Boswall's assumption that the pressure function along the length and width of a slider are independent and (2) the pressure

function along the length of the slider, i.e., in the direction of motion, is the same as that for an infinite slider.

The sector-shaped slider has been analyzed along similar lines, assuming a linear variation of viscosity as the oil flows through the bearing. Values are compared with those obtained by Boswall's and Christopherson's solutions. The agreement between the two sets of results is very close and appears to justify the assumptions made. The chief advantage is the time saved. The method described requires the use of a slide rule only, whereas Boswall's and Christopherson's methods require a calculating machine.

On the Torsional Oscillations of a Solid Sphere in a Viscous Fluid, by G. F. Carrier, Assoc. Mem. ASME, and R. C. Di Prime, Harvard University, Cambridge, Mass. 1956 ASME National Applied Mechanics Conference paper No. **56—APM-29** (in type; to be published in the *Journal of Applied Mechanics;* available to April 1, 1957).

Most treatments of the torsional oscillations of solid bodies assume that the velocity field is circumferential. In this paper the motion in planes containing the axis of oscillation is also considered. An expansion in terms of the angular displacement ϵ (assumed small) is made. The first approximation to the circumferential velocity is computed and then used in computing the first approximation to the pumping motion. This is used to compute the correction to the circumferential velocity and, in particular, the correction to the viscous torque. For the range of parameters considered it is found that the correction to the torque is of the order of $0.04\epsilon^2|N_0|$, where N_0 is the classical viscous torque. This problem is of interest in practical viscosity measurements.

On the Role of Extension in the Flexural Vibrations of Rings, by L. L. Philipson, Hughes Research Laboratories, Culver City, Calif. 1956 ASME National Applied Mechanics Conference paper No. **56—APM-2** (in type; to be published in the *Journal of Applied Mechanics;* available to April 1, 1957).

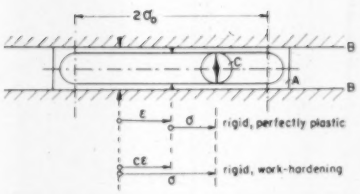
In a generalization of the classical analysis of A. E. H. Love, equations describing the flexural vibrations of thin rings are derived without making use of the usual assumption of no extension of the central line. Direct comparison with the nonextensional formulas of Love leads to a criterion for the validity of the assumption. In the process, the forced-vibration problem is shown to require the possibility of extension in certain cases in which its neglecting in a free-vibration analysis is valid.

The paper discusses the elastic vibrations of a ring segment whose central line initially describes an arc of a plane circle. It notes that confusion seems to have arisen due to Love's derivation of his equations of equilibrium with several uses of the nonextension assumption, followed by the application of the equations to a case where it is not valid. It is found that the form of Love's equilibrium equations is actually correct even when extension is permitted, but the "stress components" and "couples" in the equations have different expressions in terms of the displacement components. The more complete equations for the radial and tangential displacement components of "flexural vibrations" are established, and it is shown under what conditions these specialize to the nonextensional equations. These conditions should therefore be sufficient for the validity of the nonextension assumption.

A New Method of Analyzing Stresses and Strains in Work-Hardening Plastic Solids, by William Prager, Mem. ASME, Brown University, Providence, R. I. 1956 ASME National Applied Mechanics Conference paper No. **56—APM-34** (in type; to be published in the *Journal of Applied Mechanics;* available to April 1, 1957).

For work-hardening plastic solids, segmentwise linear yield conditions and the associated flow rules constitute a reasonable compromise between the mathematically convenient but physically unsound total stress-strain laws and the physically sound but mathematically inconvenient incremental laws. They allow total stress-strain laws to be used in the small, but retain the characteristic features of incremental laws in the large. The use of a segmentwise linear yield condition and the associated flow rule is illustrated by the analysis of the bending moments and deflections of a simply supported circular plate that is made of a work-hardening material and subjected to a uniformly distributed transverse load.

The diagram shows the simple model used to represent the mechanical behavior of plastic solids under uniaxial stress. The slotted plate A slides freely between horizontal frictionless guides B. The pin C slides without friction in the slot and imparts a motion of the plate only when it engages with one or the other end of the slot. The plate A, the guides B, and the pin C all carry a vertical index, and these indexes are originally aligned. For the rigid, perfectly plastic solid, the displacement of the pin index with respect to the plate index represents the stress σ, and the displacement of the plate index with respect to the guide index represents the strain ϵ, the total free displacement of the pin in the slot corresponding to twice the yield stress σ_0.



Kinematic model of mechanical behavior of rigid plastic solids in uniaxial stress

The same device can be used for the rigid, work-hardening solid. The manner in which stress and strain are represented in this case is indicated where c denotes the constant slope of the work-hardening branch of the stress-strain diagram.

Effect of Imperfections on Buckling of Thin Cylinders Under External Pressure, by L. H. Donnell, Mem. ASME Illinois Institute of Technology, Chicago, Ill. 1956 ASME National Applied Mechanics Conference paper No **56—APM-39** (in type; to be published in the *Journal of Applied Mechanics;* available to April 1, 1957).

The buckling of thin cylinders under external pressure is studied by finite-deflection theory, assuming the same type of imperfections as had been assumed in a previous study of buckling under axial compression. Unlike the axial compression case, only a small elastic postbuckling reduction in resistance is found, and this only for long cylinders. However, if reasonable imperfections are assumed, failure loads initiated by yielding are found to be of the same order as those indicated by experiments.

The right circular cylinder was chosen for study because the author considers it the simplest and the most practically important type of shell for buckling studies. Of isotropic material and of uniform wall thickness, it is thin enough compared to the radius to justify certain theoretical simplifications and to make at least the initial stages of buckling elastic. The most basic loadings which can produce buckling are those causing uniform axial compressive stress, uniform circumferential compressive stress combined with axial compressive stress produced by

all-around hydraulic pressure, and uniform shear stress produced by torsion. The simplest boundary conditions are those corresponding to complete cylinders having hinged or fixed end edges; these at least "bracket" the end conditions of most cylinder applications.

On the Theory of the Acceleration Damper, by Carl Grubin, Douglas Aircraft Company, Inc., Santa Monica, Calif. 1956 ASME National Applied Mechanics Conference paper No. **56—APM-10** (in type; to be published in the *Journal of Applied Mechanics;* available to April 1, 1957).

THIS paper investigates the motion of the classical single-degree-of-freedom system subjected to the action of a single-container damper. The objectives of the analysis are twofold: (1) to determine the motion of a given system with a given damper (direct problem) and (2) to determine the damper parameters necessary for reducing the vibration amplitude of a given system to a prescribed value (inverse problem).

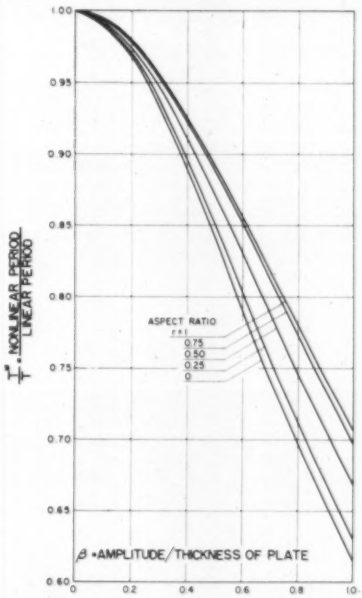
The acceleration damper reduces the vibration of a mechanical system through momentum transfer by collision and conversion of mechanical energy into heat. A typical unit consists of a mass particle moving in a container fixed to the primary vibrating system.

Two solutions are obtained for the equations governing the motion of the primary mass and the particle. The first, the complete solution, satisfies the initial conditions and determines the motion of the system from collision to collision. This calculation is tedious and does not lend itself toward solving the inverse problem. The second solution is developed by assuming the motion to be steady state. This solution is simple from the aspect of computation and permits a solution of the inverse problem. For a sufficiently large number of collisions it is found numerically that the motions predicted by the complete and steady-state solutions are in excellent agreement. The calculations also indicate that the damper is most effective at the resonant condition.

On the Stresses and Deflections of Rectangular Beams, by B. A. Boley and I. S. Tolins, Columbia University, New York, N. Y. 1956 ASME National Applied Mechanics Conference paper No. **56—APM-1** (in type; to be published in the *Journal of Applied Mechanics;* available to April 1, 1957).

THE stresses and deflections in rectangular beams and bars are calculated from the two-dimensional elasticity theory by an iterative procedure previously derived. The loading consists of either normal or shear forces varying smoothly along the span. The results are obtained in the form of infinite series, whose first terms represent the elementary solutions of strength of materials; the accuracy of the Mc/I and P/A formulas can thus be estimated. A comparison with the Timoshenko beam theory is included.

Influence of Large Amplitudes on Free Flexural Vibrations of Rectangular Elastic Plates, by Hu-Nan Chu and G. Herrmann, Mem. ASME, Columbia University, New York, N. Y. 1956 ASME National Applied Mechanics Conference paper No. **56—APM-27** (in type; to be published in the *Journal of Applied Mechanics;* available to April 1, 1957).



Influence of large amplitudes on period of vibration of a rectangular plate

FREE flexural vibrations of a rectangular elastic plate, supported by immovable hinges along all edges, are investigated in this paper. The plate equations used are those discussed in a previous paper. They may be considered the dynamic analog of the von Karman large-deflection plate theory of equilibrium and are valid for moderately large amplitudes.

These equations are also quite similar to those previously obtained by Saint Venant; if the body forces in Saint Venant's equations are taken to be the negative of the inertia forces and the transverse load is identified with the negative of the transverse inertia term, then they can be considered the same as equations of the present paper.

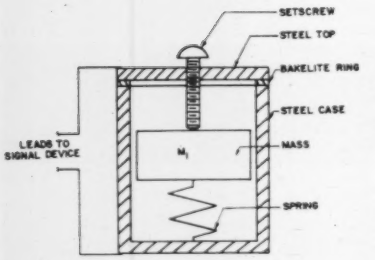
As in previous work by Carrier and Eringen, a perturbation procedure is used in the solution of the nonlinear problem. Since all the nonlinear terms are considered to be small throughout, only the lowest-order equations of motion are solved. In addition, the problem is treated by direct-energy considerations for the purpose of a verification. Graphs, indicating the influence of large amplitudes of vibration on the periodic time and on the maximum normal stress, are plotted for various aspect ratios of the plate. Finally, the vibrating beam is considered as a special case, employing again a perturbation procedure and in addition a procedure corresponding to Duffing's method for a single lumped mass. The computed values are compared with those by A. C. Eringen. All the results obtained in this study reduce readily to those of the classical linear plate theory when the amplitudes of vibration tend to zero.

The Mathematical Analysis of Bow Girders of Any Shape, by M. M. Abbassi, Alexandria University, Alexandria, Egypt. 1956 ASME National Applied Mechanics Conference paper No. **56—APM-23** (in type; to be published in the *Journal of Applied Mechanics;* available to April 1, 1957).

BY USING parametric equations in which the parameter is the angle included between the tangent at any point on the bow girder and the tangent at the middle point, the analysis of bow girders of shapes other than the circular arc can be treated mathematically. Exact and approximate formulas are given for symmetrical bow girders of any shape carrying a distributed load or two equal concentrated loads placed symmetrically with respect to the middle point of the girder.

The Effect of Spring Mass on Contact-Accelerometer Responses, by T. H. Lin, University of Detroit, Detroit, Mich. 1956 ASME National Applied Mechanics Conference paper No. **56—APM-3** (in type; to be published in the *Journal of Applied Mechanics;* available to April 1, 1957).

THEORETICAL responses of a contact-break accelerometer are analyzed for steady-state and some transient motion. The distributed mass of the spring is considered in the present analysis. For steady-state motions, viscous damping is



Schematic diagram of contact-break accelerometer

assumed to exist between the spring and the case of the instrument. Responses to simple harmonic motions of different frequencies are shown. Responses to a single cosine wave and a step function of acceleration are analyzed. The main source of error in the contact-break accelerometer is shown to be due to the spring mass. An electromagnetic-contact accelerometer with no spring mass is proposed. Preliminary study of this accelerometer is shown.

An Elastoplastic Thermal-Stress Analysis of a Free Plate, by Jerome Weiner, Columbia University, New York, N. Y. 1956 ASME National Applied Mechanics Conference paper No. **56—APM-6** (in type; to be published in the *Journal of Applied Mechanics;* available to April 1, 1957).

THE thermal stresses in a free plate of elastoplastic material subjected to a varying heat input over one face are determined. A heuristic solution is first found by suitable modifications of the known elastic solution. It is then verified that the solution satisfies all the conditions of the appropriate uniqueness theorem and represents therefore the unique solution to the problem. Residual stresses are determined and found to depend markedly on the peak magnitude of the heat input.

The elastoplastic theory utilized in this paper is based on the Prandtl-Reuss stress-strain relations with the von Mises yield condition. It is assumed in the analysis that all mechanical (and thermal) properties of the material are independent of temperature. With this assumption, the introduction of temperature effects into the usual elastoplastic theory presents no difficulties since it only affects the relationship between mean stress and strain.

The particular problem considered is that of a free plate subjected to a heat input uniformly distributed over one face, which increases monotonically from zero to a maximum value and then decays monotonically to zero. The other face and the edges of the plate are insulated. By restricting the analysis to heat inputs which do not vary too rapidly, it is possible to express the temperature distribution in the plate in a very simple form which facilitates further computations.

It is found that plastic flow first starts at the outer faces of the plates and two plastic regions grow inward. As the heat input continues to increase, plastic flow also begins at the center of the plate and a plastic region forms there. After the heat input has decayed to zero, residual stresses remain in the plate. The nature of the residual-stress distribution depends markedly on the peak magnitude of the heat input.

A Method for Determining the Flexural Effects of Statically Loaded Beams on Multiple Elastic Supports, by R. A. Di Taranto, Assoc. Mem. ASME, Radio Corporation of America, Philadelphia, Pa. 1956 ASME National Applied Mechanics Conference paper No. **56—APM-24** (in type; to be published in the *Journal of Applied Mechanics;* available to April 1, 1957).

A MEANS is presented for calculating the static deflections, slopes, moments, and shears of a nonuniform beam on two supports for any end conditions and on three simple supports when subjected to concentrated loads and/or concentrated moments. The method is an extension of a simple tabular procedure as used by Myklestad for use on a desk calculator or electronic digital computer.

The procedure is such that it may be easily carried out by one who has no knowledge of beam theory. Influence coefficients may be easily and directly calculated for nonuniform beams on two and three elastic supports. The two-support beam is formulated for simple support with one overhang, two supports with linear and torsional springs, and fixed-fixed end conditions. Extensions of this method to any other boundary conditions are indicated.

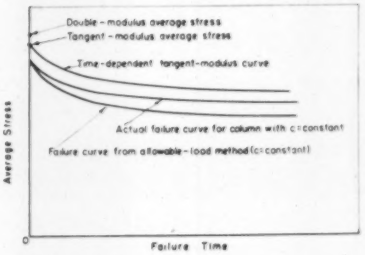
Effects of Boundary Conditions and Initial Out-of-Roundness on the Strength of Thin-Walled Cylinders Subject to External Hydrostatic Pressure, by G. D. Galletly, Assoc. Mem. ASME, Shell Development Company, Emeryville, Calif., and R. Bart, David Taylor Model Basin, Washington, D. C. 1956 ASME National Applied Mechanics Conference paper No. **56—APM-9** (in type; to be published in the *Journal of Applied Mechanics;* available to April 1, 1957).

USING classical small-deflection theory, an investigation was made of the effects of boundary conditions and initial out-of-roundness on the strength of cylinders subject to external hydrostatic pressure. The equations developed in this paper for initially out-of-round cylinders with clamped ends, and a slightly modified form of the equations previously derived by Bodner and Berks for simply supported ends, were applied to some actual test results obtained from nine steel cylinders which had been subjected to external hydrostatic pressure.

Three semiempirical methods for determining the initial out-of-roundness of the cylinders also were investigated, and these are described in the paper. The investigation indicates that, if the initial out-of-roundness is determined in a manner similar to that suggested by Holt, the correlation between the experimental and theoretical results is quite good. The investigation also indicates that, while the difference in collapse pressures for clamped-end and simply supported, perfect cylinders may be quite considerable, this does not appear to be the case when initial out-of-roundnesses of a practical magnitude are considered.

Time-Dependent Tangent Modulus Applied to Column Creep Buckling, by R. L. Carlson, Battelle Memorial Institute, Columbus, Ohio. 1956 ASME National Applied Mechanics Conference paper No. **56—APM-13** (in type; to be published in the *Journal of Applied Mechanics;* available to April 1, 1957).

THE relation of the time-dependent tangent-modulus load—as conceived by Shanley—to actual column capacity is clarified. It may be interpreted as a limiting case of the "allowable-load capacity" which has been shown to be a conservative estimate. The time-dependent tangent-modulus load is, therefore, an approximation to a conservative estimate. The approximation, however, may be either conservative or nonconservative when applied to imperfect or real columns. Typical cases are discussed and experimental results for two alloys are cited.


Double - modulus average stress
Tangent - modulus average stress
Time - dependent tangent - modulus curve
Actual failure curve for column with c = constant
Failure curve from allowable - load method (c = constant)
Average Stress
Failure Time
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Relative positions of actual and approximate column-failure curves

On the Carrying Capacity of Redundant Structures, by E. F. Masur, University of Michigan, Ann Arbor, Mich., and K. P. Milbradt, Illinois Institute of Technology, Chicago, Ill. 1956 ASME National Applied Mechanics Conference paper No. **56—APM-8** (in type; to be published in the *Journal of Applied Mechanics;* available to April 1, 1957).

AFTER establishing a generalized minimum-strain-energy principle, this paper describes a series of tests which corroborates experimentally the predictions of the nonlinear theory developed in a previous paper to show how the inclusion of certain nonlinear terms in the analysis of redundant trusses affects the predicted behavior of such structures in the post-buckling range.

In particular, it was demonstrated in that paper that the nonlinear theory predicts states of axial stress corresponding to a general stiffening of the structure compared with the results of the classical linear analysis. For example, the predicted (and measured) ultimate load of the test model amounts to about three times the load at which the linear theory predicts collapse through instability.

A similar theory dealing with the response of redundant trusses to primary bending moments is extended to certain types of singular cases which were excluded from the previous paper. It is shown analytically and verified by experiment that a constant ultimate state of axial stress may be reached already for finite applied couples. Elastic behavior is assumed throughout the paper.

ASME Transactions

for August, 1956

THE August, 1956, issue of the Transactions of the ASME (available at $1 per copy to ASME members; $1.50 to nonmembers) contains the following technical papers:

Analysis of the Stresses in a Cutting Edge, by F. R. Archibald. (53—A-160)

Use of Numerical Analysis in the Transient Solution of Two-Dimensional Heat-Transfer Problem With Natural and Forced Convection, by S. K. Hellman, George Habetler, and Harold Babrov. (54—SA-53)

Heat Transfer From a Rotating Plate, by R. L. Young. (54—SA-51)

The Thermal Conductivity of Organic Liquids, by P. F. Pagerey, C. R. St. Clair, and W. L. Sibbitt. (54—SA-55)

The Determination of Thermal Diffusivity of Aluminum Alloys at Various Temperatures by Means of a Moving Heat Source, by Daniel Rosenthal and N. E. Friedmann. (54—SA-56)

An Electrolytic Analog Applied to Heat Conduction Within a Transistor, by P. E. McNall, Jr., and J. E. Janssen. (54—SA-45)

Temperature Charts for Internal Heat Generation, by M. P. Heisler. (54—SA-44)

Preliminary Investigation of Minimum Oil-Feed Rates for Fluid-Film Conditions in Journal Bearings, by D. D. Fuller and Beno Sternlicht. (54—A-107)

Feedwater Heaters—A User's Viewpoint, by S. M. Arnow. (54—A-129)

Measurement of Mean Fluid Temperatures, by Lloyd Trefethen. (54—A-135)

Stress Distribution and Design Data for Adhesive Lap Joints Between Circular Tubes, by J. L. Lubkin and Eric Reissner. (55—SA-59)

Metal Transport in Liquid-Water Systems and Effect on Heat Transfer, by S. C. Datsko. (55—A-183)

The Sintering Test, an Index to Ash-Fouling Tendency, by D. H. Barnhart and P. C. Williams. (55—A-193)

Combustion Calculations for Multiple Fuels, by Tibor Buna. (55—A-185)

Correlation of Fir-Tree-Type Turbine-Blade-Fastening Strength With Mechanical Properties of Materials, by A. G. Holms and A. J. Repko. (55—A-122)

Application of Internal Liquid Cooling to Gas-Turbine Rotors, by Sumner Alpert, R. E. Grey, and D. D. Drake. (55—A-202)

Solution of Transient Heat-Transfer Problems by the Resistance-Network Analog Method, by G. Liebmann. (55—A-61)

Engineering Relations for Heat Transfer and Friction in High-Velocity Laminar and Turbulent Boundary-Layer Flow Over Surfaces With Constant Pressure and Temperature, by E. R. G. Eckert. (55—A-31)

The Viscosity of Steam, Heavy-Water Vapor, and Argon at Atmospheric Pressure Up to High Temperatures, by C. F. Bonilla, S. J. Wang, and H. Weiner. (55—A-6)

High-Speed Guarded-Hot-Plate Apparatus for Thermal Conductivity of Thermal Insulation, by E. V. Somers. (55—A-129)

Water-Column Separation in Pump Discharge Lines, by R. T. Richards. (55—A-74)

Hydraulic Transients in Centrifugal Pump Systems, by C. P. Kittredge. (55—A-72)

Surge-Wave Velocity—Concrete Pressure Pipe, by H. F. Kennison. (55—A-75)

Water-Hammer Calculations and Test Results—Owens Gorge Power Plant Penstocks, by A. E. Bratfisch and K. O. Cartwright. (55—A-71)

Design Basis for Multiloop Positional Servomechanisms, by Sidney Lees. (55—A-126)

Control-Valve Plug Design, by J. A. Wiedmann and W. J. Rowan. (55—A-103)

Pullman-Standard's Train X, by T. C. Gray. (55—A-140)

Factors Influencing the Dynamic Behavior of Tall Stacks Under the Action of Wind, by M. S. Ozker and J. O. Smith. (55—A-69)

Design of a Large Coal-Fired Steam Generator for 200 F Exit-Gas Temperature and Operating Experience With Pilot Plant, by W. L. Wingert and R. J. Stanley. (55—A-143)

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Comments on Papers

Including Letters From Readers on Miscellaneous Subjects

Engineering for Profit

Comment by Bruce B. Watson[1]

In a recent paper[2] the statement is made that profits can be improved by the engineering department by (1) action which reduces costs in other departments, and (2) action which reduces costs in the engineering department.

Nowhere in the paper do we see a reference to legal requirements affecting design, but it rather states, "Close supervision is required to insure that each part and product are engineered at minimum manufacturing cost compatible with required quality and performance," and also that it is accomplished through a simple design in order to lower the cost of the product. This is an all too prevalent attitude of younger engineers, which reflects both on their school and their company when a design built into a finished product has to be reworked to be within the law.

Another item that the young engineer is apt to miss, owing to lack of experience, is the maintenance angle. If a design cannot be simply and cheaply maintained, all reduction in costs of manufacture and design are worthless. Not infrequently, the customer has considerable trouble in impressing on his supplier just what he wants and that which the designer may look upon as an inherent foible has sound engineering basis in industry, in the maintenance field, and as established by federal and state laws.

The statement is made that "Engineering drawings can be simplified by eliminating nonessentials, simplifying delineation, and stripping all frills which do not result in a loss of clarity or accuracy." This is probably true in the case of young engineers working for young industries. But the work of simplification in the engineering profession, since it has been in existence especially in the older basic industries, should not be disparaged, as naturally the leaders of today did not arrive without sound engineering principles. However, bringing these items to the attention of a young engineer by another young engineer is certainly a worth-while endeavor.

[1] Chief Inspector, Test Department, The Pennsylvania Railroad, Altoona, Pa. Mem. ASME.

[2] "How to Improve Profits—A Challenge to Engineering," by K. L. Block, Mechanical Engineering, vol. 78, February, 1956, pp. 135–136.

Synthetic Lumber

Comment by L. J. Markwardt[3]

The subject of fiberboards[4] is particularly timely because of the rapid expansion of the industry, increased interest in, and use of, fiberboard products, and because of the potential the industry offers in providing effective utilization of residual wood material. The authors have contributed an interesting and very worth-while paper in this field by presenting information on German processes for the production of what they call "synthetic lumber," or wood "shaving board," employing specially cut shavings as the wood particles. This type of fiberboard as referred to broadly in United States terminology is designated as particle board. Information on the processes developed in Europe have been somewhat fragmentary in American literature. Hence this paper is a valuable contribution in that it consolidates the information into a single paper that will be a valuable reference to anyone who is interested in utilizing wood residues, machinery for fiberboard manufacture, or types of boards that may be produced.

It is recognized that much pioneering work in the development of production techniques for the manufacture of resin-bonded wood-particle board has been carried on in Europe and particularly in Germany in the years immediately following the war. Many of the European processes have been licensed in the United States. It is of course the purpose of the paper to present a rather complete summary of the German processes. In an over-all appraisal of the development of fiberboard-manufacturing techniques, however, it should not be overlooked that there has been a substantial American development that has likewise produced economical as well as successful manufacturing processes and machinery.

In this connection, it may be pointed out that there are at least three flake-making machines available commercially that are capable of producing flakes of a quality comparable to those of European origin. These are those of Long Bell Lumber Company, American Manufacturing Company, Seattle, and James d'A Clark and Associates.

As mentioned in the foregoing, it should be noted that the nomenclature used by the authors does not conform to that generally used in the American industry. Usually all of the boards manufactured from distinct particles of wood bonded together with a synthetic resin are called particle boards or more completely resin-bonded wood-particle boards. Particles may be of some special type such as granules, slivers, strands, shavings, or flakes. Shavings boards are manufactured from shavings produced from lengthwise cutting of a shaper or planer knife. Cross-cut flakes, such as the authors describe, are prepared by cutting parallel to the grain but across the fiber to keep fiber damage to a minimum. It is generally regarded as the superior type of particle for boards. Boards made from flakes are called flake boards rather than shavings boards.

[3] Assistant Director, Forest Products Laboratory, U. S. Department of Agriculture, Madison, Wis.

[4] "Manufacturing Synthetic Lumber in Germany," by A. Elmendorf, W. Klauditz, and A. Lühning, Mechanical Engineering, vol. 78, April, 1956, pp. 310–314.

Authors' Closure

The term "synthetic lumber" was used in view of the fact that the major use of the product is that of a core material for furniture panels where it replaces lumber. The term "shaving board" was used to correspond to the German name "Spanplatte," in which Span means shaving.

The authors are familiar with the discussions of the subcommittee of the Committee on Wood of A.S.T.M. dealing with nomenclature pertaining to composite boards and recognize that, lacking a better term, wood technologists are beginning to accept the term "particle board" to cover all boards made of sub-

divided wood bonded together with a resin. It was felt, however, that until agreement has been reached by the A.S.T.M. committee it would be best to abide by the layman's concept of the terms. To the layman, particles of wood resemble something similar to sawdust, and shavings something similar to the slice produced by a pocket knife. The layman seeing a shaving, calls it a shaving, not a particle. In popular parlance a particle of wood is simply a very small amorphous element of wood, and a shaving a thin broad element resulting from cutting with the edge of a knife. There are, of course, various types of shavings such as those produced by a rotating cutter head called planer shavings, those produced by a knife cutting across the grain sometimes called flakes, there are narrow flakes best referred to as strands, and, finally, there are the well-known, long, slender shavings called excelsior.

Boards made of any type of shaving could, therefore, be called shaving boards, and the authors recognize that technical accuracy would require the use of the term "flake board" to refer to most of the composite boards made abroad.

A. Elmendorf.[5]
W. Klauditz.[6]
A. Lühning.[7]

Spring Materials[8]

Comment by Tore Franzen[9]

It is the writer's opinion that in order to be worthy of its title and to rank as "technical," this paper[10] should contain a great deal more information. It does contain a list of reference material which in a measure makes up for this deficiency.

In considering the subject the following information may be of value:

Chrome Vanadium (Table 2). This is not a popular steel; it has a limited use in the medium high-temperature field.

Silico-Manganese. Where high hardenability is required as in large helical springs, large torsion bars, and heavy-section leaf springs, it is still used. Silico-manganese steel was never used extensively in knee-action springs and contrary to the author's statement, chrome vanadium is not used at all for this purpose.

Helical front springs for automobiles are with few exceptions made from SAE 5160; it is safe to state that over 70,000 tons of this material will go into automotive front springs this year.

The author states that stresses have been reduced in valve springs; on the contrary, torsional stresses designed into valve springs are much higher now than they were in the early 1920's.

Chrome-vanadium wire is not used in any production automobile-engine valve springs today. One maker specifies chrome silicone; all others call for high-carbon valve-spring-quality spring wire.

Table 6. The great bulk of spiral springs used by the millions in the automotive industry, are made from SAE 1065 and SAE 1050 steel.

Fig. 1. The writer is not qualified to discuss the data in the Hunter Spring Company table. He does know, however, that some oil-tempered wire-base prices are tied to a given size and that there is an extra for both lighter and heavier gages below and above the base size.

Comment by T. R. Green[11]

This paper should be helpful to both well-experienced engineers and those who are just getting into the problems of spring design. However, the listing of the alloys Elgiloy and Dynavar in Table 7, "Constant Modulus Alloys," was undoubtedly an oversight on the author's part.

Elgiloy is not a constant-modulus material. Its thermoelastic coefficient is -39.6×10^{-5} from 0 C to 50 C. Table 1, herewith, also will show the change in the shear modulus from room temperature to 1000 F.

Table 1 Changes in Shear Modulus of Elgiloy

Wire diam, in.	Room temp, 10^6 psi	600 F, 10^6 psi	800 F, 10^6 psi	1000 F, 10^6 psi
0.063	12.18	10.98	10.57	9.98
0.121	12.54	11.28	10.94	10.39

The spring industry is fast leaving the field of art and becoming an industry based on science. The spring industry is now using newer and better materials and the most advanced techniques of production which was not the case just a few years ago. The author is to be commended for his attempt to group spring materials for ease of selection by engineers and designers.

Comment by S. M. Rimmer[12]

This paper will be helpful to all persons involved in spring-design problems.

In our experience in manufacturing springs we have encountered problems that may be eliminated by the use of the materials specified in this paper.

High-Carbon Spring Steels

Music Wire. In cadmium-coated music wire we find that the wire-drawing mills require a somewhat lower tensile strength than in the case of plain wire and the material must be selected to meet some of the government specifications. Most wire-drawing mills do not supply all sizes of this wire with the ability to withstand the 100-hr salt-spray test. In reference to its withstanding high stresses, the statement should be confined to the smaller sizes of the wire.

Hard Draw HB Grade. While this material has many advantages as stated in the paper and should be used more often, its present demand restricts the wire mills to relatively large minimum quantities so that its price advantage is lost in many cases in small-quantity lots of springs. If engineering departments will take advantage of this material it will then be economical for spring manufacturers to stock a larger variety of sizes of this grade material.

Beryllium Copper. This alloy is no longer furnished at $2\frac{1}{4}$ per cent Be. Present practice gives Be usually under 2 per cent. This has had the effect of making the consistent attainment of tabulated hardness more difficult.

70-80C. The color and finish of spring steel have always been associated with quality. Actually the only benefit obtained from the various finishes used is appearance.

90-1.05C. Hardenability is not generally a problem in this grade if performed by heat-treating procedures properly controlled for this material. The chief characteristic of this high-carbon steel is less set at extremely high stresses. The performance of these grades depends to an inordinate extent on the manufacturing practice, so that specifying the grade alone is no guarantee of optimum properties. The properties

[5] President, Elmendorf Research, Inc., Chicago, Ill.

[6] Doctor of Engineering, Director, Forest Products Laboratory, Braunschweig, Germany.

[7] Doctor of Engineering, Laboratory Director, Western Nu-Ply Corporation, South Bend, Wash.

[8] Parts of this discussion refer to the complete paper, No. 55—A-76, and not to the condensed version published in Mechanical Engineering.

[9] Grosse Pointe, Mich.

[10] "Selection and Application of Spring Materials," by H. C. R. Carlson, Mechanical Engineering, vol. 78, April, 1956, pp. 331–334.

[11] Technical Director, Abrasives Division, Elgin National Watch Company, Elgin, Ill.

[12] Spring Manufacturing Superintendent, Wallace Barnes Company, Bristol, Conn. Mem. ASME.

of the best stock, which includes American and some Swedish steel, are by far the highest obtainable in any flat material at ambient temperature.

Constant Modulus (Table 7). Our data on one test of Elgiloy indicate that it would sustain stresses of 70,000 psi up to 750 F and not 1000 F as the author claims (with a set of 5 per cent). Stresses below 50,000 psi cause excessive set at 900 F, if heat-setting operations are not used.

Comment by F. P. Zimmerli[13]

In our opinion the author has made an outstanding collection of data to help and encourage the draftsman and occasional spring designer. For this he is to be both congratulated and thanked by the spring industry.

The material presented is mostly of such a caliber and so standard that outside of its excellence of choice there are few commentaries for the reviewer. This is as it should be.

In reading the paper there were a few very minor matters on which we would like to suggest possible changes. These are:

1 The heading for Table 2 states that alloy steels will withstand both higher and lower temperatures than the carbon steels. This is certainly true regarding elevated temperatures. Our tests down to —75 F and 10 million cycles do not show carbon steel, valve-spring grade, inferior to alloy steels.

2 In Table 2 under "silico-manganese" steels, the intimation that the 9260 steel is being replaced by chrome vanadium is not in line with our information. On a price, not quality basis, the 51 hundred series of steels are being used in many instances, usually 5150 or 5160 SAE instead of 9260.

3 The heading for Table 3 explains lack of valve-spring failures as due, among other things, to lower stresses than in earlier years. Our experience is quite the contrary; the 60,000 psi of the 1920's has become over 90,000 in the 1950's. We feel the improvement is due to improved design, better wire, and the use of shot-peening.

4 There is, we believe, a typographical error in Table 6 (in the complete paper) under "beryllium-copper" type. The specification number should be ASTM B 197–52 not E 197–52 and the beryllium specified in said specification is 1.8 to 2.05 not 2¼ per cent.

Author's Closure

The author is indeed grateful for the many comments that his paper has elicited and feels that each comment is worthy of individual attention.

Mr. Tore Franzen states that the paper should contain more information to rate as a "technical" paper. In making this terse comment, it is evident he either ignored or forgot to read the purpose in the abstract or the paragraphs describing the scope of the tables. He also states that chrome vanadium is not a popular steel. In this he errs somewhat because this material is extensively used in aircraft-engine valve springs, in landing-gear wheel-retraction mounts, in guns, and in many applications where springs are subjected to shock loading.

From the remarks he makes regarding chrome vanadium, it is apparent that Mr. Franzen has either very little liking or little experience with applications of this alloy. For the record it should be made clear that this alloy has many important applications. One spring company in the East employs 55 men who have been making springs only from this material for the past 17 years, and they are still working with it! For this reason, among others, the ASTM, SAE, and the U. S. Government have found it desirable to prepare as many as seven standard specifications to cover it!

In connection with his statement about silico-manganese and knee-action springs, we refer directly to *Iron Age* (March 28, 1934, page 25-B), which describes how this material was the first steel used for this purpose by Buick. Mr. Franzen is partially correct in stating that stresses in valve springs are higher today than in the 1920's, but he overlooks the fact that the first couple of active coils in such springs are now coiled at a low pitch and these coils which absorb the first shock are lower-stressed owing to this reduced pitch. In referring to Table 6 which covers only flat cold-rolled strip, he states, "The great bulk of spiral springs used by the millions in the automotive industry are made from SAE 1065 and SAE 1050." Apparently Mr. Franzen did not read the heading or is confused. This table covers the two very popular flat-spring steels such as clock-spring steel, used in over 95 per cent of all flat-spring applications.

In commenting on Fig. 1 which shows the relative cost of spring materials, Mr. Franzen states he is not qualified to discuss the data. He follows this remark by the observation, "prices are tied to a given size," yet this is precisely what the curves and the descriptive paragraph above it show!

Mr. T. R. Green is to be commended for his remarks and for his interesting table showing the change in modulus for Elgiloy from room temperature to 1000 F. However, the temperatures covered in the paper are only from —50 to plus 150 F. In this restricted low-temperature range, the change in modulus for Elgiloy and Dynavar is so slight that it is insignificant for practical purposes. For this reason, these two alloys were included in Table 7 for "Constant Modulus Alloys"; otherwise they might be overlooked by designers interested in determining which spring materials are suitable for use in instruments.

Mr. S. M. Rimmer makes some interesting observations and the author is indebted to him for the additional worthwhile data submitted. With regard to the use of Elgiloy at 750 and not 1000 F, however, some differing results have been recorded. One spring manufacturer hardened this material to Rockwell C51 and used it successfully at 1000 F at stresses of 75,000 psi, but admits that the time at heat was intermittent and the permanent set slightly over 5 per cent. Some more research work and high-temperature testing need to be done on such materials and it is hoped that Mr. Rimmer can be induced to undertake the job.

Mr. F. P. Zimmerli has been very gracious in his remarks and the author wishes to thank him for his helpful comments. Mr. Zimmerli is recognized as one of the leading engineers and metallurgists in the spring industry both in the United States and abroad. It is always desirable and helpful to have a paper commented upon by such a well-known authority, and the author is grateful to Mr. Zimmerli for his encouraging statements and practical observations.

H. C. R. Carlson.[14]

Nodular Iron

Comment by S. B. Bailey[15]

It is very encouraging to hear of 37 per cent savings in cost when replacing malleable-iron switchgear castings by nodular-iron castings, and 45 per cent savings as compared with steel castings.[16] Can the author say what proportion of these savings was due to reduced casting scrap percentage in each case?

The cost of making nodular-graphite cast iron can be profoundly affected by the raw material used and the nodulizing method adopted. How much scrap

[13] Director, Engineering and Research, Associated Spring Corporation, Bristol, Conn.

[14] President, The Carlson Company, New York, N. Y. Mem. ASME.

[15] United Kingdom Scientific Mission, Washington, D. C.

[16] "Nodular Iron in Switchgear," by F. E. Florschutz, Mechanical Engineering, vol. 78, April, 1956, pp. 327–328.

steel does the author's firm use in the furnace charge, and what is the average sulphur content of the metal treated? Finally, is he using the magnesium/nickel process or direct magnesium treatment?

Comment by E. L. Layland[17]

This is an interesting and informative report on the use of nodular iron in switchgear. The successful use of this new engineering material in the applications discussed by the author and in many other types of equipment should induce designers to consider it for parts which in the past would have been made as a malleable-iron casting, as a steel casting, as a steel forging, or as a steel weldment. This is not meant to imply that nodular iron is equal to or superior to these materials in all applications with respect to cost and quality. It does mean that nodular iron should be considered because in some cases it will be found superior.

Most of the applications of nodular iron by the writer's company have required the annealed type. Some large users of nodular iron use primarily the as-cast grade. The versatility of this material is shown by the fact that it can be used in other conditions also. It can be normalized to achieve somewhat greater strength that is obtainable in the as-cast grade, which of course is stronger than the annealed grade. Also it can be quenched and tempered in a manner similar to that for a structural alloy steel to obtain a yield strength as high as 150,000 psi. Also nodular iron can be case-hardened by induction heating and by flame hardening.

The author recommends co-operation between the designer and the foundryman to achieve sound castings. This, of course, is excellent advice with regard to all types of castings, ferrous and nonferrous. This co-operation is particularly important for high-strength castings such as nodular iron because only sound castings can attain the potential strength and ductility indicated by the test bars which are used to judge these properties of the casting.

[17] Supervising Engineer, Metallurgical Application Section, Materials Engineering Department, Westinghouse Electric Corporation, Pittsburgh, Pa.

Author's Closure

Mr. Bailey's comments call for the following answers:

1 The savings are based on the casting cost to the Switchgear Division as a user, and of course, in the case of cast steel the additional saving to us in machining.

We do not know the relative scrap percentage at the foundry. However that factor may be reflected in the relative casting cost to us.

2 At the author's company nodular iron is made in both a basic cupola and in a basic electric furnace. In the former about 40 per cent steel scrap and 60 per cent pig iron are charged, whereas in the latter there is no steel in the charge.

3 In both melting units the sulphur content at tap averages about .02 per cent with a range of about .015 to .030 per cent.

4 The nodulizing treatment used by the author's company uses a nickel magnesium alloy for most nodular-iron production. In some cases the nodulizing agent is an iron silicon magnesium alloy.

F. E. Florschutz.[18]

[18] Advisory Engineer, Westinghouse Electric Corporation, East Pittsburgh, Pa. Mem. ASME.

Reviews of Books

And Notes on Books Received in Engineering Societies Library

Engineering in History

ENGINEERING IN HISTORY. By R. S. Kirby, Sidney Withington, A. B. Darling, and F. G. Kilgour. McGraw-Hill Book Company, Inc., New York, N. Y., 1956. Cloth, 5½ × 9 in., figs., references, bibliography, index, vii and 530 pp., $8.50.

Reviewed by Walter D. Binger[1]

BY A LUCKY fusion four enthusiasts each grounded in a phase of this great subject have combined to write a first-rate book. For "Engineering in History" is true to its title; the authors have not tried to write a history of engineering. They have produced an easily readable nontechnical account in which each age has been made to extrude the engineering on which it depended for its growth.

The work of the civil engineers has been much written about before because it comprises the monuments which have survived from antiquity and because it stems from the earth-shaking ventures of their forbears, the military engineers. So to this reviewer the test of achievement is the authors' ability to treat the history and development of *engines* of every kind in a logical and interesting way. These were made really useful only in comparatively recent times and have not the aura of great antiquity about them. A more difficult assignment and how well they have succeeded with it!

One wonders if, when Hannibal's roads, Caesar's bridges, the aquaducts, the moles, and the walls are known to engineers, it is not as members of the public rather than as engineers. For, sad to say, the modern engineer has generally no wide acquaintance with the rich background of his own profession.

In this book under review we should not expect to find, in a chapter called Bridges, everything the authors have to say about them. The earliest bridges are here mentioned under "Urban Society," that form of living which led to creation of the city-state. They are treated under "Imperial Civilization," again under "The Industrial Revolution," and finally "Iron and Steel." The bridge, you see, has been integrated into history.

And as one reads about the ships, engines, canals, water wheels, about the buildings and railroads, about early mining and metallurgy, one is reading the history of Europe, Britain, the Middle East, and Africa. Surely it is a branch

[1] Consulting engineer, New York, N. Y., and author of "What Engineers Do."

of history far more vital and more fascinating than that devoted to the succession of rulers and their wars already known to most from childhood. To many this book will be a new experience.

Books Received in Library

ACCIDENT PREVENTION MANUAL FOR INDUSTRIAL OPERATIONS. Third edition, 1955. National Safety Council, Chicago, Ill. Various paging, 5 3/4 × 9 in., bound. $13.50. A comprehensive compilation of practical information on industrial safety principles and techniques, prepared by engineers of the National Safety Council and experts from industry. The manual is divided into forty-three sections covering both general principles and practices of interest to all industry—education, organizing a program, records, and techniques essential to the safe operation and maintenance of different types of equipment: boilers, pressure vessels, conveyers, machine tools, elevators, and power trucks. Many local and federal government standards and those of code-making associations are cited in the text.

APPLIED AUTOMATION. A group of significant articles from the pages of *Automotive Industries*. Edited by James R. Custer. 1956, Chilton Company, Philadelphia, Pa. 236p., 8 1/2 × 11 1/4 in., bound. $6. These articles cover automation in machining, stamping, welding, forging, heat-treating, plating, painting, inspection, testing, assembling, and other operations in the automobile and aircraft industries. The book is indexed by broad subjects.

ASTM STANDARDS ON LIGHT METALS AND ALLOYS. Published 1955 by The American Society for Testing Materials, Philadelphia, Pa. 277p., 5 7/8 × 8 7/8 in., paper. $3.50. These standards include specifications for wrought products for electrical purposes (bus bars, steel core wire for aluminum conductors, hard-drawn aluminum wire, etc.), as well as for ingots, castings, bars, forgings, pipe and tube, sheet and plate, and other products. General methods of test and the ASTM codification system for these materials are also included.

AUTOMATIC DATA PROCESSING. Proceedings of the Conference, September, 1955. Edited by Robert N. Anthony. 1956, Graduate School of Business Administration, Harvard University, Boston, Mass. 194p., 5 1/4 × 8 1/8 in., paper. $3.50. This conference was held in order to acquaint engineers with the requirements of businessmen for data processing and to acquaint businessmen with the potential uses and limitations of new equipment. The conference consisted of five sessions at which papers covering the following subjects were presented: basic principles and techniques; centralization versus decentralization of data processing in large companies; recent developments in equipment; applications to ordering, production planning, and payroll; and the relationship of operations research to automatic data processing.

BELASTUNGSGLIEDER. By Adolf Kleinlogel and Arthur Haselbach. Eighth edition, 1956, Wilhelm Ernst and Sohn, Berlin, Germany. 263p., 6 1/8 × 9 5/8 in., bound. 27.50 DM. This practical manual presents formulas and tables of static and elastic values for simple and fixed beams. Part 1 discusses fundamental beam formulas and their uses; Part 2 in this new edition has been enlarged to include detailed treatments of 135 specific load cases, and the number of numerical tables has also been increased.

COMPUTERS: THEIR OPERATION AND APPLICATIONS. By Edmund C. Berkeley and Lawrence Wainwright. 1956, Reinhold Publishing Company, New York, N. Y. 366p., 6 × 9 in., bound. $8. Basic information is presented on the elements, reliability, maintenance, advantages, and limitations of analog and digital computers, including large-scale and miniature types. A fairly extensive section on applications gives brief notes on a wide range of actual and potential, business, military, and other uses of computers. Also included are a list of computers now in operation, a roster of organizations offering consulting and other services, a glossary, and a selected bibliography.

DESIGN MANUAL FOR ROLLER AND SILENT CHAIN DRIVES. Prepared by Jackson and Moreland. 1955, Association of Roller and Silent Chain Manufacturers, Indianapolis, Ind. 95p., 8 3/8 × 11 1/8 in., bound. $3.50. A practical manual covering the design of roller chains and sprockets, procedures for selecting roller-chain drives for given requirements, and roller-chain installation, lubrication, and maintenance. A chapter on the design of silent chain drives, a brief history of chain drive, and a discussion of the relative merits of chains, gears, and belts are also included.

DIESEL ENGINE CATALOG. Volume 21, 1956–1957. Edited by Rex W. Wadman. 1956, *Diesel Progress*, 816 North La Cienega Blvd., Los Angeles, Calif. 374p., 10 1/2 × 13 1/2 in., paper. $10. Details of the construction and operation of the engines of the major manufacturers are provided in this annual guide to the diesel industry. Information is also given on the products of supercharger, turbocharger, transmission, and equipment manufacturers; a classified buyers' guide is included.

ELEMENTARY NUCLEAR THEORY. By Hans A. Bethe and Philip Morrison. Second edition, 1956. John Wiley and Sons, Inc., New York, N. Y. 274p., 5 7/8 × 9 1/4 in., bound. $6.25. This is an introduction to the subject for students and scientists who are not specialists in nuclear physics. As in the first edition, the central theme is the problem of nuclear forces treated from the empirical point of view. In this revision, more space has been devoted to the structure and reactions of heavier nuclei. In addition, the book has been expanded to twice the number of pages in order to take into account theoretical and experimental advances, particularly in the energy range of hundreds of Mev. The appended table of nuclear species and their masses has also been revised.

50 JAHRE GRENZSCHICHTFORSCHUNG. Eine Festschrift zu Ehren von Ludwig Prandtl. Edited by H. Görtler and W. Tollmien. 1955, Friedr. Vieweg und Sohn Verlag, Braunschweig, Germany. 499 p., 6 5/8 × 9 5/8 in., bound. 66 DM. A compilation of 44 original contributions in boundary-layer research comprising a memorial volume to Ludwig Prandtl. A wide range of subject matter is included: mathematical analyses of various aspects; boundary-layer phenomena in liquids, gases, and electron streams; heat transfer and turbulence effects; experimental methods, measurements, and computations; similitude investigations; and several specialized items, such as the use of the sailplane in boundary-layer research. Over half of the papers are in English, the rest mainly in German.

FLOW OF GASES THROUGH POROUS MEDIA. By P. C. Carman. 1956, Academic Press, Inc., New York, N. Y. 182p., 5 3/8 × 8 3/4 in., bound. $6. An integrated and, as far as possible, quantitative account of flow in and through fine-pored media, with emphasis on theory and experimental methods rather than specific applications. Approaching the subject from the Kozeny theory, the author deals in seven concise chapters with such topics as flow through unconsolidated beds, the permeability method of surface measurement, the separation of gas mixtures, diffusional flow, and the transition to turbulent flow. References are listed after each chapter.

FUNDAMENTALS OF VIBRATION ANALYSIS. By N. O. Myklestad. 1956, McGraw-Hill Book Company, Inc., New York, N. Y. 260p., 6 × 9 1/4 in., bound. $6.50. The first half of this introductory text deals with systems of one degree of freedom and is developed along the same lines as the author's "Vibration Analysis." The second half, devoted to systems of more than one degree of freedom is entirely new except for the last chapter on numerical methods of analysis. A large number of examples and problems are introduced throughout the text.

DIE GEGOSSENEN METALLISCHEN WERKSTOFFE. By Erwin Knipp. 1956, Giesserei-Verlag, Düsseldorf, Germany. 173p., 6 1/4 × 9 1/8 in., bound. 17.50 DM. A tabular presentation of the composition, applications, properties, and other data of 472 cast metals for gray-iron castings, malleable-iron castings, steel castings, heavy and light metal castings, and cast-bearing metals. The properties data cover mechanical and physical properties, and heat and corrosion resistance. The listings are so arranged as to facilitate reference from one major section to another, and the book is designed for practical use.

INDUSTRIAL ORGANIZATION AND MANAGEMENT. By Lawrence L. Bethel and others. Third edition, 1956, McGraw-Hill Book Company, Inc., New York, N. Y. 719p., 6 × 9 1/4 in., bound. $5.75. A text and reference book presenting a broad picture of the functions of an industrial enterprise: plant engineering, research engineering, quality control, production control, industrial relations, accounting, etc. This edition takes into account developments in automation, operations research, and applications of electronics

Library Services

ENGINEERING Societies Library books may be borrowed by mail by ASME Members for a small handling charge. The Library also prepares bibliographies, maintains search and photostat services, and can provide microfilm copies of any items in its collection. Address inquiries to Ralph H. Phelps, Director, Engineering Societies Library, 29 West 39th St., New York 18, N. Y.

to plant and office operations, as well as new policies and practices in a number of fields.

MARINE CARGO OPERATIONS. By Charles L. Sauerbier. 1956, John Wiley and Sons, New York, N. Y. 548p., $5^7/_8 \times 9^1/_4$ in., bound. $10.50. The main part of this detailed treatment of the theory and techniques of efficient and economical cargo handling deals with the following subjects: weight distribution, stability, longitudinal stress, and other principles; planning for stowage; stowage of different types of cargo; loading and discharging equipment; materials-handling principles and equipment; and ventilation of cargo holds. Two short chapters are devoted to admistrative organization for handling cargo and to responsibility for cargo. The last chapter reviews recent research in the field.

MECHANICAL PROPERTIES OF WROUGHT PHOSPHOR BRONZE ALLOYS. (Special Technical Publication No. 183.) By G. R. Gohn, Jr., P. Guerard, and H. S. Freynik. Published 1956 by the American Society for Testing Materials, Philadelphia, Pa. 114p., 6×9 in., paper. $3. A systematic study of the effects of variations in tin and phosphorus contents, cold working, and variations in grain size on the mechanical properties of phosphor bronze strip and electrolytic tough-pitch copper strip. Tensile strength, proportional limit, yield strength, modulus of elasticity, elongation, bending-fatigue characteristics, and other properties are reported for six tempers of each of the materials studied.

MECHANICAL VIBRATIONS. By J. P. Den Hartog. Fourth edition, 1956. McGraw-Hill Book Company, Inc., New York, N. Y. 436p., $6 \times 9^1/_4$ in., bound. $9. This standard work is a systematic presentation of vibration phenomena, with emphasis on the application of principles and calculations to practical problems encountered by engineers. For the present edition, changes have been made in every chapter to bring the text up to date and numerous problems have been added. As in previous editions, complete explanations and proofs are given without using mathematics higher than simple differentiations and integrations.

MOLECULAR FLOW OF GASES. By G. N. Patterson. 1956, John Wiley and Sons, Inc., New York, N. Y. 217p., $5^7/_8 \times 9^1/_4$ in., bound. $7.50. In this book for engineers and physicists, the characteristics of the isentropic and nonisentropic flow of a monatomic gas are determined from an assumed molecular model and the distribution of the velocities of the molecules. One chapter is devoted to the mechanics of rarefied gases, and some discussion of strong shock waves is included in which effects arising from complex molecules are considered. Material from both the kinetic theory of gases and fluid mechanics is used to develop and illustrate the molecular approach.

OPERATIONS RESEARCH FOR MANAGEMENT. Volume 2. Edited by Joseph F. McCloskey and John M. Coppinger. 1956, The Johns Hopkins Press, Homewood, Baltimore, Md. 563p., $6 \times 9^1/_4$ in., bound. $8. The first part of this book consists of thirteen reports on the application of operations research to such problems as traffic delays at toll booths, ore-handling at British ports, the influence of vehicle speed and spacing on tunnel capacity, analysis of a railroad classification yard, and inventory control. The design of experiments, analyzing failures, operational gaming, and other methods are discussed in the second part. The last part deals with problems of group communication and organization.

POLYESTERS AND THEIR APPLICATIONS. By Bjorksten Research Laboratories, Inc., Madison, Wisconsin. 1956, Reinhold Publishing Corporation, New York, N. Y. 618p., $5^7/_8 \times 9$ in., bound. $10. A comprehensive summary of information on raw materials, resin manufacture, fillers, reinforcements, shaping, finishing, and uses of polyesters, including both unsaturated and saturated (linear fiber-forming and di-isocyanate-modified). A brief exposition of the theory of high polymers and of polyesters is included, and separate sections are devoted to physical properties of commercial resins, testing methods, and health hazards. The accompanying bibliography of over 3000 annotated references covers patents, books, articles, and manufacturers' publications.

RANDOM PROCESSES IN AUTOMATIC CONTROL. By J. Halcombe Laning, Jr., and Richard H. Battin. 1956, McGraw-Hill Book Company, Inc., New York, N. Y. 434p., $6 \times 9^1/_4$ in., bound. $10. The first part of this book deals with the fundamental concepts of probability theory and of the statistical properties of random functions of time. These basic concepts are then applied to the study of the shot effect and Gaussian random functions. Later chapters treat stationary random processes as inputs to time-invariant linear systems; mean-squared error analysis in time-variable linear systems; optimum systems synthesis; and optimum operations with finite data. Supplementary material, which includes a discussion of the theory of the operation of analog computers, is given in appendixes.

REACTOR SHIELDING DESIGN MANUAL. Edited by Theodore Rockwell, 3rd. First edition, 1956. D. Van Nostrand Company, Inc., Princeton, N. J. 472p., $8 \times 10^3/_4$ in., bound. $6. A detailed presentation of procedures and data used in the design, construction, and testing of shielding for the reactor plants of the Naval Reactors Program and for the Shippingport Pressurized Water Reactor. Intended as a practical guide for designers of stationary as well as mobile reactors, the manual covers basic theory, setting allowable radiation levels, core and cooling-system shields, plant layout as a factor in design, materials, provision for access for repair and maintenance, the effect of irregularities in shields, and the effect of the geometry of radiation. Basic data and calculation aids are provided in the last chapter.

SEMINAR ON AUTOMATION, PROCEEDINGS. (Pennsylvania State University, June, 1955). Edited by Chester Linsky. Available from Extension Conference Center, The Pennsylvania State University, University Park, Pa. Various paging, $8^3/_8 \times 10^7/_8$ in., paper. $5. These proceedings include the papers, workshop discussions, and question-and-answer sessions which made up a seminar held for product designers and manufacturing engineers interested in learning the tools and techniques associated with the organization, planning, design, and operation of automated systems. The twenty papers and one panel discussion included deal with machine-tool automation, hydraulics in automation, process controls, automatic-assembly machines, digital control, economic considerations, labor problems, and related topics. A number of full-page photographic reproductions are used to illustrate the papers.

SOLID STATE PHYSICS. Volume 2. Edited by Frederick Seitz and David Turnbull. 1956, Academic Press, Inc., publishers, New York, N. Y. 468p., $6 \times 9^1/_4$ in., bound. $10. The second volume in a projected series of about a dozen volumes intended to provide concise and authoritative reviews of important areas of the field. The present volume consists of five papers on the following subjects: nuclear magnetic resonance; electron paramagnetism and nuclear magnetic resonance in metals; applications of neutron diffraction to solid-state problems; the theory of specific heats and lattice vibrations; and displacement of atoms during irradiation. Bibliographical footnotes accompany each paper, and a subject index and index of authors cited are included.

SPANENDE WERKZEUGMASCHINEN; GRUNDLAGEN UND KONSTRUKTIONEN. By Friedrich Schwerd. 1956, Springer-Verlag, Berlin, Germany. 543p., $7^5/_8 \times 10^3/_4$ in., bound. 78 DM. A comprehensive textbook on metal-cutting tools which covers the theory of cutting, the design of machine tools, speed and feed diagrams and standards, mechanical drives and their control, hydraulic and electric accessories, lubrication, and specific details of various types of machine tools from lathes to gear-cutting machines. A brief introductory chapter presents a historical review of machine-tool development.

STEEL SKELETON. Volume 2. Plastic Behaviour and Design. By J. F. Baker, M. R. Horne, and J. Heyman. 1956, Cambridge University Press, Cambridge, England. 408p., $6^7/_8 \times 10^3/_8$ in., bound. $12. The first volume of this work was a report of investigations made on the elastic behavior of steel structures. In this volume detailed accounts are given of tests and theoretical studies on rigid frames, beams, and columns, made in order to develop a simplified method for the design of steel structures, based on their plastic behavior. A proposed design method for multistory frames is presented and some actual applications of the method are briefly described.

TECHNOLOGY OF HEAT. By H. Wright Baker. 1956, Longmans, Green and Company, Inc., New York, N. Y. 427p., $6^1/_8 \times 10$ in., bound. $7. A concise presentation of the fundamentals of thermodynamics, this text covers working fluids and fluid mixtures; working cycles; reversibility and entropy; fuels and combustion; theory of compressors; steam engines and gas turbines; internal-combustion engines; the gas turbine; refrigerators and heat pumps; heat transfer; waste-heat recovery; and principles of testing.

ÜBERSPANNUNGEN IN ENERGIEVERSORGUNGSNETZEN. By Herbert Baatz. 1956, Springer-Verlag, Berlin, Germany. 295p., $6^1/_8 \times 9^1/_4$ in., bound. 34.50 DM. A text on surges in high-voltage power systems that emphasizes lightning and over-voltage protection of overhead lines and distribution systems. Intended for power network engineers and students, the practical aspects are based on a thorough theoretical treatment. An extensive classified bibliography is included.

VAPOR-LIQUID EQUILIBRIUM DATA. By Ju Chin Chu and others. 1956, J. W. Edwards, Publisher, Inc., Ann Arbor, Michigan. 754p., $5^1/_2 \times 8^1/_2$ in., paper. $9. Data for 466 systems from 274 references, expressed in terms of mole percentage, are tabulated, together with temperature in deg C and pressure in mm of Hg. The compilation is in alphabetical order by the common name of the component which is more volatile than the others in the pure state and is indexed by formulas. The source of the data is indicated by a number referring to the bibliography following the tables.

ASME News

With Notes on Society Activities and Events

E. S. Newman, *News Editor*

1956 ASME Annual Meeting Program, Nov. 25-30, Surpasses Past Record in Scope and Diversity

- *Statler and McAlpin Hotels, Meeting Headquarters*
- *More than 100 technical sessions to be conducted*
- *1956 National Power Show at New York Coliseum*
- *International Conference on the Fatigue of Metals*
- *Inspection trips, social events, women's program*

In anticipation of the thousands of engineers who will convene in New York, N. Y., from November 25 to 30 to attend the 1956 Annual Meeting of The American Society of Mechanical Engineers, the Society has designated two headquarters hotels, the Statler and the Sheraton-McAlpin, to insure the best accommodations for a more comfortable sojourn with the utmost convenience for members and guests.

Registration desks will be operated at both hotels and the activities of the respective divisions and committees will be concentrated at one of the two locations, thereby making it possible for each member to register at the hotel at which meetings of most interest to him will be held. Both hotels are connected by an underpass so that in inclement weather the trips back and forth would not cause any discomfort. The hotels recently have been renovated.

One factor that made possible the shift to two hotels instead of three as in the past was the decision of the American Rocket Society, an affiliate of ASME, to hold its annual meeting at a new location, the Henry Hudson Hotel. No single hotel, of course, can accommodate the anticipated attendance at the Annual Meeting.

A glance at the tentative program in its present skeletal form shows more than 100 technical sessions and features, including such outstanding events as the President's Luncheon on Monday, November 26, and the Annual Banquet on Wednesday evening, November 28. Inspection trips to industrial installations under the sponsorship of the Metropolitan Section of the Society also will be conducted.

A list of the Professional Divisions and the hotels at which their activities will be concentrated will appear in the October, 1956, issue of Mechanical Engineering.

General view of the new New York Coliseum where the National Power Show will be held concurrently with the 1956 ASME Annual Meeting

Events of Interest

During the Annual Meeting week the International Conference on Fatigue of Metals, scheduled for presentation September 10-14 in London, England, will be re-presented for the benefit of the American audience.

The conference program has been rearranged so that it may be presented in three days instead of five as is the case in London. To provide maximum time for discussion, papers will not be read by their authors, but will be presented by the "Reporter System." A complete schedule of papers can be found on page 876 of this issue.

Another meeting-week feature is the National Power and Mechanical Engineering Show which will be staged at the new Coli-

seum, located at Columbus Circle, a short distance from either of the headquarters hotels, readily accessible by bus, subway, or taxi. More than 200 manufacturers will maintain displays of boilers, steam generators, steam engines, turbines, turbogenerators, and related equipment. A separate section of the Power Show will be devoted to atomic power, including models of new reactors, a gas turbine for atomic-plant use, and materials relating to various operations in the application of atomic energy to industrial purposes.

Also between November 26 and 29 the American Rocket Society, an ASME affiliate, will hold its annual meeting at the Henry Hudson Hotel. The program lists 12 technical sessions and the annual symposium on "Space Flight." In addition, attempts are being made to organize a classified session on "Operation Vanguard," the earth-satellite project.

Admiral James Russell, chief of the U. S. Navy Bureau of Aeronautics, will be principal speaker at the ARS Honors Night Dinner.

Women's Program

An elaborate program has been arranged for the women; as a matter of fact, the Annual Meeting has become as much an event for the women as it is for the men. The program includes sight-seeing tours, a tea dance, buffet supper, and a "sufficient" amount of time has been ticketed for shopping. The Metropolitan Section of the Woman's Auxiliary to the ASME is in charge of this phase of the program.

More About the Hotels

The Sheraton-McAlpin, which has been extensively renovated since it was acquired by the Sheraton Corporation a year ago, features rebuilt meeting and public rooms and completely refurnished personal quarters. Rooms reserved for persons who will be attending the ASME meeting feature new furnishings, fresh decoration, and radios. Many of the rooms have television sets.

The Hotel Statler—ASME's home-away-from-home in New York—has also undergone considerable renovation. As part of the modernization program the hotel has installed an extensive air-conditioning system. Both the President's Luncheon and the Annual Banquet will be held in the Grand Ballroom of the Statler.

The Hotel Statler, one of the headquarters hotels where the 1956 ASME Annual Meeting will be held from November 25 to 30

The hotels are situated in New York's world-famous shopping area and nearby are several sight-seeing attractions including the Empire State Building. Other sections of the city, such as the theatrical, financial, and commercial, are easily reached via rapid-transit subway systems, and local buses. Nearby interstate bus and railroad line terminals make it easy to plan trips to other points of interest.

The members and guests who plan to attend the Annual Meeting are urged to make their requests for hotel accommodations as early as possible. A form will be enclosed in the advance program scheduled for mailing to members of the Society early in October.

Sheraton-McAlpin Hotel entrance which will become a familiar spot during the 1956 ASME Annual Meeting, November 25 to 30

International Conference on Fatigue of Metals Featured During ASME Annual Meeting, November 28–30

An International Conference on Fatigue of Metals is being held in London, England, Sept. 10–14, 1956, under the auspices of The Institution of Mechanical Engineers (Great Britain). The American Society of Mechanical Engineers is co-operating in this conference by securing U. S. A. papers and by re-presenting the papers in New York, N. Y., on November 28–30 during the 1956 Annual Meeting.

Because of the large number of papers at each session, authors will not present their papers in person, but rather, a reporter will summarize all of the papers to be presented at the session. This will allow a maximum amount of time for new discussion.

Complete sets of papers will be available through the ASME Order Department in advance as well as during the Conference. Anyone interested in discussing the papers should be sure to order his papers well ahead. It is hoped that each discusser will present his material in person at the Conference, but if this is not possible, written discussion will be accepted if sent to Fatigue Conference, ASME, 29 West 39th Street, New York 18, N. Y.

The tentative program follows:

WEDNESDAY, NOVEMBER 28

8:00 a.m.

Registration

9:00 a.m.

Session 1—Basic Studies

The Distinction Between Initiation and Propagation of a Fatigue Crack, by *J. A. Bennett,* National Bureau of Standards

The Basic Mechanism of Fatigue and Its Dependence on the Initial State of Material, by *P. J. E. Forsyth,* Royal Aircraft Establishment

Some Observations on the Microstructure of a Brass Containing 67 Per Cent of Copper, Subjected to Alternating Bending Stresses, by *P. A. Jacquet,* Laboratoires de Résistance des Matériaux et de Physique des Métaux, Paris, France

The Growth of Fatigue Cracks Under Plastic Torsion, by *F. A. McClintock,* Massachusetts Institute of Technology

Studies in the Formation and Propagation of Cracks in Fatigue Specimens, by *N. E. Frost* and *C. E. Phillips,* Mechanical Engineering Research Laboratory

Failure of Metals Under Cyclic Strain, by *W. A. Wood,* University of Melbourne

Experiments Relating to the Basic Mechanism of Fatigue, by *N. Thompson,* University of Bristol

The Behavior of Single Crystals of Iron Under Fatigue Loading, by *H. A. Lipsitt* and *G. T. Horne,* Carnegie Institute of Technology

Hardness Changes During Fatigue Tests in Copper, by *R. B. Davies, J. Y. Mann,* and *D. S. Kemsley,* Department of Supply, Australia

Metallographic Observations on the Fatigue of Steels, by *M. Hempel,* Max Planck Institute

2:00 p.m.

Session 2—Stress Distribution

The Usefulness and Role of Repeated Strain Testing as an Aid to Engineering Design and Practice, by *R. W. Bailey,* Metropolitan Vickers

Allowance for Stress Concentration, by *H. J. Grover,* Battelle Memorial Institute

Effect of Unintentional Stress Raisers on the Fatigue Strength of Structural Components, by *E. C. Hartmann,* Aluminum Company of America

Damping and Resonant Behavior of Materials, by *B. J. Lazan,* Minnesota University

Interpretation of Fatigue Strengths for Combined Stresses, by *Joseph Marin,* Pennsylvania State University

A Method of Estimating the Fatigue Strength of Small Ellipsoidal Cavities, by *R. E. Peterson,* Westinghouse

Short Endurance Fatigue Tests, by *A. C. Low,* Mechanical Engineering Research Laboratory

A Means of Revealing the Danger Point in Pieces or Structures, by *H. de Leiris,* République Française Marine Nationale

Fatigue Behavior of a Nickel-Chromium-Manganese Steel Under Combined Bending and Torsion, by *W. N. Findley, Mr. Coleman,* and *Mr. Hanley,* Brown University

Stress Concentration in Relation to Fatigue, by *H. L. Cox,* National Physical Laboratory

The Influence of Plastic Deformation on Notch Sensitivity in Fatigue, by *P. G. Forrest,* National Physical Laboratory

The Effect of the Mean Stress Upon the Endurance of an Alloy Steel, by *H. C. O'Connor,* University of Bristol

An Analysis of the Effects of Shot Peening Upon the Fatigue Strength of Hardened and Tempered Spring Steel, by *A. G. H. Coombs, F. Sherratt,* and *J. A. Pope,* University of Nottingham

Fatigue of Curved Surfaces in Contact Under Repeated Load Cycles, by *N. G. Kennedy*

THURSDAY, NOVEMBER 29

8:00 a.m.

Registration

9:00 a.m.

Session 3—Stress Distribution, Statistical Aspects, and Effect of Frequency

Cumulative Fatigue Damage by *H. T. Corten* and *T. J. Dolan,* University of Illinois

Cumulative Damage Under Random Loading, by *S. M. Freudenthal,* Columbia University

Distribution Functions for the Prediction of Fatigue Life and Fatigue Strength, by *A. M. Freudenthal* and *E. J. Gumbel,* Columbia University

The Influence of Fillet Radius on the Fatigue Strengths of Large Steel Shafts, by *S. F. Dorey* and *G. P. Smedley,* Lloyd's Register

Random Noise-Fatigue Testing, by *A. K. Head* and *F. H. Hooke,* Department of Supply, Australia

Influence of Residual Stresses in the Fatigue Limit, by *H. Sigwart,* Daimler Benz

Effect of Variable Load and Cumulative Damage on Fatigue in Vehicle and Aircraft Structures, by *E. Gassner,* Laboratorium für Betriebsfestigkeit, Darmstadt

Investigation of the Effect of Surface Finish on the Fatigue Strength of Metal-Construction Parts, by *E. Siebel* and *M. Gaier,* Technische Hochschule, Stuttgart

Design of Screw Fastenings Under Repeated Stress, by *A. Erker,* M.A.N., Nuremberg

Very-High-Speed Fatigue Testing, by *A. R. Wade* and *P. Grootenhuis,* Imperial College

The Influence of Frequency of Vibration on the Endurance Limits of Various Alloys at Speeds up to 150,000 Cycles per Minute, Using a Pneumatic Resonance System, by *J. R. Rait, T. W. Lomas, J. O. Ward,* and *E. W. Colbeck,* Hadfields, Ltd.

A Study of the Strain Cycling and Fatigue Behavior of a Cold-Worked Steel, by *L. F. Coffin* and *J. H. Read,* General Electric Company and Knolls Atomic Power Laboratory

Relation of Inclusions to the Fatigue Properties of High-Strength Steels, by *F. B. Stulen, H. N. Cummings,* and *W. C. Schulte,* Curtiss-Wright.

12:15 p.m.

LUNCHEON

Presiding: *R. E. Peterson,* Westinghouse Research Laboratories

Speaker: *H. J. Gough*

2:30 p.m.

Session 4—Metallurgical Aspects, Effects of Temperature, Corrosion

The Influence of Temperature Upon the Fatigue of Metals, by *N. P. Allen* and *P. G. Forrest,* National Physical Laboratory

Corrosion Fatigue, by *A. J. Gould,* Natal University

An Investigation of the Corrosion-Fatigue Failure of Marine-Propeller Shafts, by *S. Hara,* Japanese Marine Corporation

Fretting Corrosion and Its Influence on Fatigue, by *A. J. Fenner, K. H. R. Wright,* and *A. Y. Mann,* Mechanical Engineering Research Laboratory

Corrosion Fatigue in Power Plant: Thermal Stressing by Cooling of Hot Surfaces With Water, by *A. H. Goodger,* National Boiler & General Insurance Co.

Fatigue Properties of Steel at Higher Temperatures, by *F. Wever,* Max Planck Institute

Fatigue of Large Shafts by Fretting Corrosion, by *O. J. Horger,* Timkin Roller Bearing Co., Ohio

The Reactions of High-Strength Aluminum Alloys to Alternating Stress, by *R. F. Hanstock,* High Duty Alloys, Ltd.

Hydrogen Occlusion and Its Effect on the Fatigue Properties of Plain Carbon Spring Steels, by *J. S. Jackson,* British Thompson-Houston

Fatigue Properties of Some Nonferrous Metals Other Than Light Alloys, by *J. McKeown,* British Non-ferrous Metals Research Association

Fatigue of High-Tensile Alloy Steels, by *P. H. Frith,* Bristol Aircraft, Ltd.

The Influence of Some Surface Factors on the Torsional Fatigue Strength of Spring Steels, by *J. F. Watkinson,* B.S.A.

Strength Reduction Factors for Small Quenching Cracks and for Decarburized Steel, by *J. A. Pope* and *C. W. Barson,* University of Nottingham

Fatigue of Aluminum Alloys, by *G. Forrest,* Aluminium Laboratories, Ltd.

FRIDAY, NOVEMBER 30

8:00 a.m.

Registration

9:00 a.m.

Session 5—Engineering and Industrial Significance of Fatigue—General Service, Automobiles, Railways, Marine Engines, Aircraft Engines, Welding

Lessons to Be Learned From Failures in Service, by *G. A. Cottell,* British Engine Boiler & Electrical Insurance Co.

The Fatigue Testing of Compression-Type Coil Springs, by *J. A. Pope* and *R. C. Coates,* University of Nottingham

Fatigue in Plain Bearings, by *W. E. Duckworth* and *G. H. Walter,* Glacier Metal Co.

Fatigue in Automobiles, by *R. J. Love,* Motor Industry Research Association

Service Experience and Fatigue Failures, by *R. Cazaud,* Irsid

Fatigue Effects in Automobile Engineering, by *R. C. Mattson,* General Motors

Fatigue Tests on Seamless Mild Steel Pipe Bends, by *P. H. R. Lane,* British Welding Research Association

Fatigue Tests in Welded Box-Section Beams, by *R. P. Newman* and *G. Coates,* British Welding Research Association

The Significance of the Fatigue of Metals to the Railways, by *T. Baldwin,* British Railways

The Fatigue Problem in Welded Construction, by *R. Weck,* University of Cambridge

Fatigue in Railroad Equipment, by *W. M. Keller* and *G. M. Magee,* American Railroad Association

Fatigue Failures in Marine Machinery, by *T. W. Bunyan,* Lloyd's Register

Some Studies in the Pitting of Marine-Reduction Gears, by *J. Hoshimo,* Japanese Marine Corporation

Shot Peening as Protection of Surface-Damaged Propeller-Blade Materials, by *John M. Lessells* and *Ronald F. Brodrick,* Lessels and Associates, Inc.

Fatigue in Aero-Engines, by *E. R. Gadd,* Bristol Engine Company

2:00 p.m.

Session 6—Engineering and Industrial Significance of Fatigue—Aircraft Structures

An Investigation Into the Fatigue Characteristics of a Typical 24 S-T Aluminium-Alloy Wing, by *A. O. Payne,* Department of Supply, Australia

Observation in the Design of Fatigue Resistant and "Fail-Safe" Aircraft Structures, by *E. H. Spaulding,* Lockheed Aircraft Corporation

Fatigue-Loading Actions on Transport Aircraft, by *J. Taylor,* Royal Aircraft Establishment

Aircraft Fatigue From the General Engineering Standpoint, by *P. B. Walker,* Royal Aircraft Establishment

3:30 p.m.

Reporters Summaries and Closure

K. W. Clendinning, Managing Editor, Died August 16

KATHERINE WALSH CLENDINNING (Mrs. Chauncey H. Durkee), managing editor of MECHANICAL ENGINEERING, Transactions of the ASME, and *Journal of Applied Mechanics,* died Thursday, Aug. 16, 1956, after having been stricken by a cerebral hemorrhage at her desk.

Mrs. Durkee, known professionally by her maiden name, had been a member of the staff of the publications for 40 years.

A native of Yarmouth, Nova Scotia, Mrs. Durkee received the AB degree, in 1915, from Cornell University, where she was a member of Delta Gamma Sorority and one of the editors of the 1915 "Cornellian." She joined the staff of MECHANICAL ENGINEERING in 1917 as an assistant to Lester G. French, ASME editor from 1908 until his death in 1921.

She was responsible for production of the "ASME News" during the years when that semi-monthly was issued by the Society. When Transactions and *Journal of Applied Mechanics* became periodical publications, she took over the production of them in addition to MECHANICAL ENGINEERING and "ASME News." Her work for these publications brought her in close contact with authors and members of the Society.

Mrs. Durkee is survived by her husband, Chauncey H. Durkee, Mem. ASME, a retired electrical engineer, of 440 East 23rd Street, New York, N. Y., and a sister, Miss Sarah Clendenning.

ASME-ASLE Lubrication Conference Will Feature Nuclear Sessions

Chalfonte-Haddon Hall, Atlantic City, N. J., Headquarters for Conference, October 8–10

THE Lubrication Conference, sponsored jointly by the Lubrication Division of The American Society of Mechanical Engineers and the American Society of Lubrication Engineers, will open on October 8 with two sessions on "Bearing and Lubricant Problems in Nuclear-Power Plants." Other sessions included will cover "Friction and Boundary Lubrication," "Hydrodynamic Lubrication," and "Lubricants."

One of the main features of the Conference will be the method of presenting the 13 papers at the "Hydrodynamic Lubrication" session. The European "reporter system" will be used for presenting the papers whereby two reporters will summarize all of the papers scheduled for the session. This will permit a maximum amount of time for the presentation of discussion. The session is programmed on Wednesday, the final day of the Conference, so as to allow each registrant an opportunity to digest the papers before attending the session.

Philadelphia Sections of both ASME and ASLE will be host to the Conference. Although no formal program for the women has been planned, activities will be arranged for their pleasure during the Conference technical session time.

The program in detail follows:

MONDAY, OCTOBER 8

10:00 a.m.

Session (I) Bearing and Lubricant Problems in Nuclear-Power Plants, Part I

Vice-Chairman: *Edmond E. Bisson*, assistant chief, Flight Problems Research Division, NACA, Cleveland, Ohio

Application Problems With Petroleum Lubricants in Nuclear-Power Plants, by *R. F. Hausman* and *E. R. Booser*, Atomic Power Equipment Department, General Electric Co., Schenectady, N. Y. (ASLE Paper No. 56—LC-7)

General Radiation-Damage Problems for Lubricant and Bearing-Type Materials, by *V. P. Calkins* and *C. G. Collins*, aircraft nuclear-propulsion department, General Electric Co., Cincinnati, Ohio (ASLE Paper No. 56—LC-2)

2:00 p.m.

Session (II) Bearing and Lubricant Problems in Nuclear-Power Plants, Part 2

Vice-Chairman: *Edmond E. Bisson*, assistant chief, Flight Problems Research Division, NACA, Cleveland, Ohio

Use of Rolling Contact Bearings in Low Viscosity Liquid Metal Lubricants, by *W. Markert, Jr.*, and *K. Mildred Ferguson*, The Babcock and Wilcox Co., Alliance, Ohio (ASLE Paper No. 56—LC-3)

Radiation Resistant Greases, by *J. G. Carroll, R. O. Bolt*, and *B. W. Hotten*, California Research Corp., Richmond, Calif. (ASLE Paper No. 56—LC-4)

Effects of Nuclear Radiation on Lubricants, by *J. A. King* and *W. L. R. Rice*, Wright Air Development Center, Wright Patterson AFB, Ohio (ASLE Paper No. 56—LC-5)

TUESDAY, OCTOBER 9

9:00 a.m.

Session (III) Friction and Boundary Lubrication, Part 1

Vice-Chairman: *E. Rabinowicz*, Massachusetts Institute of Technology, Cambridge, Mass.

A Fundamental Study of Synthetic Sapphire as a Bearing Material, by *L. R. Coffin, Jr.*, General Electric Co., Schenectady, N. Y. (ASLE Paper No. 56—LC-6)

Statistical Analysis of a Wear Process, by *B. G. Rightmire*, Massachusetts Institute of Technology (ASME Paper)

On Sliding Friction Between Unlubricated Metallic Surfaces, by *F. F. Ling* and *E. Saible*, Carnegie Institute of Technology (ASLE Paper No. 56—LC-7)

2:00 p.m.

Session (IV) Friction and Boundary Lubrication, Part 2

Vice-Chairman: *A. C. West*, California Research Corp., Richmond, Calif.

Solid Film Lubricants—Factors Influencing Their Mechanism of Friction and Wear, by *R. E. Crump*, Electrofilm Corp., North Hollywood, Calif. (ASLE Paper No. 56—LC-8)

Influence of Temperature on Boundary Lubrication, by *C. W. Cowley, D. J. Ultee*, and *C. W. West*, Linde Air Products, New York, N. Y. (ASLE Paper No. 56—LC-18)

Fretting of Hardened Steel in Oil, by *J. R. McDowell*, Research Laboratories, Westinghouse Electrical Co., Pittsburgh, Pa. (ASLE Paper No. 56—LC-9)

PbO and Other Metal Oxides as Solid Lubricants to 1000 F, by *M. B. Peterson*, General Engineering Laboratories, General Electric Co., and *R. L. Johnson*, NACA, Cleveland, Ohio (ASLE Paper No. 56—LC-10)

WEDNESDAY, OCTOBER 10

9:00 a.m.

Session (V) Hydrodynamic Lubrication—Reporter Session

Vice-Chairman: *F. W. Ocvirk*, associate professor, mechanical engineering, Cornell University, Ithaca, N. Y.

Reporter: *Milton Shaw*, professor, Massachusetts Institute of Technology, Cambridge, Mass.

Experiments on Gas Lubricated Journal Bearings, by *M. Wildmann*, Autonetics Division, North American Aviation, Bellflower, Calif. (ASME Paper)

Testing Dynamically Loaded Bearings (1) A Short History of Bearing Test Machines, by *Mayo D. Hersey* and *Ralph B. Snapp*, Bearings Section, Internal Combustion Engine Laboratory, U. S. Naval Experiment Station, Annapolis, Md. (ASME Paper No. 56—LUB-3)

Testing Dynamically Loaded Bearings (2) A Diesel Bearing Test Machine, by *Ralph B. Snapp*, Bearings Section, Internal Combustion Engine Laboratory, and *Mayo D. Hersey*, U. S. Naval Experiment Station, Annapolis, Md. (ASME Paper No. 56—LUB-4)

Universal Bearing Tester, by *R. J. S. Pigott* and *B. R. Walsh*, Gulf Research and Development Co., Pittsburgh, Pa. (ASME Paper)

Properties of Misaligned Journal Bearings, by *G. B. DuBois, F. W. Ocvirk*, and *R. L. Wehe*, Cornell University, Ithaca, N. Y. (ASME Paper)

Investigation of "Melt Lubrication," by *B. Sternlicht* and *H. Apkarian*, General Electric Co., Schenectady, N. Y. (ASLE Paper)
Reporter: *J. T. Burwell, Jr.*, Horizons, Inc., Cleveland, Ohio

Surface Roughness, A Criterion for Minimum Hydrodynamic Oil-Film Thickness of Short Journal Bearings, by *L. F. Kreisle*, University of Texas, Austin, Texas (ASME Paper No. 56—LUB-5)

Analysis of Journal Bearings With Arbitrary Load Vector, by *O. Pinkus*, General Electric Co., Lynn, Mass. (ASME Paper No. 56—LUB-2)

Temperature Effects in Journal-Bearing Lubrication, by *W. F. Hughes* and *J. F. Osterle*, Carnegie Institute of Technology, Pittsburgh, Pa. (ASLE Paper)

The Fluid Dynamic Theory of Gas Lubricated Bearings, by *J. S. Ausman*, Autonetics Division, North American Aviation, Garden Grove, Calif. (ASME Paper)

Heat-Transfer Effects in Hydrostatic Thrust-Bearing Lubrication, by *W. F. Hughes* and *J. F. Osterle*, Carnegie Institute of Technology, Pittsburgh, Pa. (ASME Paper)

A Solution for the Finite Journal Bearings and Its Application to Analysis and Design, (2) by *A. A. Raimondi* and *John Boyd*, Westinghouse Research Laboratories, Pittsburgh, Pa. (ASLE Paper No. 56—LC-12)

On the Theory of Grease-Lubricated Thrust Bearings, by *A. Sibar* and *P. R. Paslay*, General Electric Co., Schenectady, N. Y. (ASME Paper No. 56—LUB-1)

2:00 p.m.

Session (VI) Lubricants

Vice-Chairman: *H. A. Hartung*, Atlantic Refining Co., Philadelphia, Pa.

Yield Stress as a Factor in the Performance of Greases, by *D. Evans, J. F. Hutton*, and *J. B. Matthews*, Shell Research, Ltd., Chester, England. (ASLE Paper No. 56—LC-14)

Specific Heat at Low Temperatures and Latent Heat of Fusion of Aircraft-Engine Lubricants, by *V. E. Schrock*, University of California, Berkeley, Calif., and *R. E. Gott*, General Electric Co., Richland, Wash. (ASLE Paper No. 56—LC-16)

Thermal Conductivity and Thermal Diffusivity of Aircraft-Engine Lubricants at Low Temperatures, by *V. E. Schrock* and *E. S. Starkman*, University of California, Berkeley, Calif. (ASLE Paper No. 56—LC-17)

Orders for Lubrication Conference Papers

ONLY copies of *numbered* papers will be available. Some of the papers may not be available in time for you to receive them in advance of the Conference.

ASME Papers

Copies of ASME papers may be obtained by writing to the ASME Order Department, 29 West 39th Street, New York 18, N. Y. Papers are priced at 25 cents each to members and 50 cents each to nonmembers. Only *numbered* papers are available in pamphlet form. Please order only by paper *number*, otherwise the order will be returned.

ASLE Papers

Copies of ASLE papers may be ordered by writing to ASLE, 84 East Randolph Street, Chicago, Ill. Papers are priced at 35 cents each to members and 50 cents each to nonmembers. Only the *numbered* papers are available in pamphlet form. Please order by paper *number* only.

UPADI Plans October Meeting in Mexico

THE Pan American Federation of Engineering Societies (UPADI) will hold its fourth convention in Mexico City, Mexico, Oct. 8 through 12, 1956. Host for the meeting will be the Unión Mexicana de Asociaciones de Ingenieros. Engineers from the United States, Canada, and Latin America are expected to attend.

The United States delegation will be headed by James M. Todd of New Orleans, past-president of ASME. Vice-chairman of the delegation will be Gail A. Hathaway, who is also the present chairman of the EJC Committee on International Relations, and past-president of ASCE. Other members of the delegation will include Enoch R. Needles, president of ASCE; J. W. Barker, President ASME; Carlton Proctor, past-president of ASCE; Louis R. Howson, vice-president ASCE; A. J. Ackerman; George E. Brandow; George Browne; William N. Carey; C. E. Davies, secretary ASME; Stewart E. Reimel; William H. Wisely; Guy V. Woody.

The convention is primarily a business meeting but the committee sessions will provide opportunities to exchange information and ideas. In addition, there will be a series of round-table discussions on particular subjects such as engineering education with engineers from various nations participating.

Of special importance is the decision to hold a meeting of the Pan American Standards Committee (CPNT) in conjunction with the fourth UPADI convention. Standards organizations in Argentina, Chile, Mexico, Brazil, Uruguay, and the United States have indicated a desire to have this meeting, the purpose of which will be to organize the Pan American standards movement.

Engineers in the United States who would like to attend the Convention in Mexico City or who would like more information on UPADI should communicate with Brig. Gen. (ret.) S. E. Reimel, Committee on International Relations, EJC, at 29 West 39th Street, New York 18, N. Y.

1956 ASME-AIME Solid Fuels Conference, Washington, D. C., October 25-26

THE nineteenth meeting of the Fuels Division of The American Society of Mechanical Engineers and the Coal Division of the American Institute of Mining, Metallurgical, and Petroleum Engineers will be held in Washington, D. C., at the Sheraton-Park Hotel on October 25 and 26. They will discuss technical and economic developments of importance in the fuels field as they affect the nation. The theme of the Conference is "The Future Role of Solid Fuels in an Expanding Economy."

The Conference Committee is completing the details of what promises to be an interesting program, including technical and social events. The Woman's Auxiliary of the Washington Section is arranging a program of events and visits to various historical tourist spots, of which there are so many in the beautiful capitol city.

The program follows:

THURSDAY, OCTOBER 25

8:30 a.m. — **Lobby—Near Continental Room**

Registration

10:00 a.m. — **Continental Room**

Technical Session (I)

Chairman: *W. S. Major*, project engineer, Machinery Division, Dravo Corporation, Pittsburgh, Pa.

Co-Chairman: *Glynn Coryell*, engineering consultant, engineering department, National Coal Association, Washington, D. C.

A Recent Development in an Expanding Spreader-Stoker Field,[1] by *F. Guy*, Detroit Stoker Company, Detroit, Mich.

Effect of Atomic Energy on Future Use of Fossil Fuels,[1] by *R. C. Dalzell*, Reactor Development Division, Atomic Energy Commission, Washington, D. C., and *Harry Perry*, Branch of Bituminous Coal Research, Bureau of Mines, Washington, D. C.

Determination of Heat Content of Coal by Regression Analysis,[1] by *R. L. Pasek*, Northwestern University School of Commerce, Chicago, Ill., and *R. M. Lundberg*, Commonwealth Edison Company, Chicago, Ill.

12:30 p.m. — **Burgundy Room**

Luncheon

Chairman: *L. C. McCabe*, president, Resources Research, Inc., Washington, D. C.

Speaker: *Joseph W. Barker*, ASME President

[1] Papers not available—see box on this page.

2:00 p.m. — **Continental Room**

Technical Session (II)

Chairman: *A. C. Fieldner*, formerly chief fuels technologist, U. S. Bureau of Mines, Washington, D. C.

Co-Chairman: *Lloyd M. Smith*, consulting mining engineer, Washington, D. C.

Government Development and Research Activity in Solid Fuels,[1] by *T. Reed Scollon*, Division of Bituminous Coal, and *Harry Perry*, Branch of Bituminous Coal Research, Inc., Bureau of Mines, Washington, D. C.

Underground-Coal Gasification,[1] by *C. A. Masterman*, British Ministry of Fuel and Power, London, England

Coal-Industry Research,[1] by *Harold J. Rose* and *James R. Garvey*, Bituminous Coal Research, Inc., Columbus, Ohio

4:00 p.m.

Executive Committee, Fuels Division, ASME, Mural Room

Executive Committee, Coal Division, AIME, Madison Suite

4:30 p.m. — **Mural Room**

Joint Conference Committee Meeting

6:00 p.m. — **Caribar Room**

Cocktail Hour

7:00 p.m. — **Burgundy Room**

Banquet

Chairman: *L. F. Deming*, head, Power Generating Section, Bureau of Yards and Docks, Department of Navy, Washington, D. C.

Toastmaster: *S. L. Jewell*, vice-president and director of public relations, Peabody Coal Company, and vice-president, Southern Coals, Inc., Chicago, Ill.

Entertainment: United States Navy "Sea Chanters" directed by Warrant Officer *Harold Fultz*

Presentation of Percy Nicholls Award for 1956

Recipient: *Chester A. Reed*
Presenter: *Carl T. Hayden*

FRIDAY, OCTOBER 26

8:30 a.m. — **Continental Room**

Registration

9:30 a.m. — **Continental Room**

Technical Session (III)

Chairman: *John F. Barkley*, chief coal technologist, Bureau of Mines, Washington, D. C.

Co-chairman: *Herbert G. Bryan*, director, Utilities Division, District Public Works Office Potomac River Naval Command, Washington, D. C.

Fly-Ash Refiring,[1] by *W. W. Maull*, Marion Generating Station, Public Service Electric and Gas Company, Jersey City, N. J., and *E. C. McMahon*, Sewaren Generating Station, Public Service Electric and Gas Company, Sewaren, N. J.

Symposium: Ignitibility of Fresh Fuel and Reactivity of Residual Carbon

Norman D. Phillips, Research Division, The Babcock & Wilcox Company, Alliance, Ohio

Alexander Bogot, service engineer, Combustion Engineering, Inc., New York, N. Y.

F. J. Ceely, design engineer, Steam Division, Foster Wheeler Corporation, New York, N. Y.

2:00 p.m. — **Continental Room**

Technical Session (IV)

Chairman: *Edward Steidle*, chairman, Federal Coal Mine Safety Board of Review, Washington, D. C.

Co-Chairman: *H. B. Charmbury*, College of Mineral Industries, the Pennsylvania State University, University Park, Pa.

Coal as Source of Power for Aluminum Industry,[1] by *F. G. Feeley, Jr.*, Olin Mathieson Chemical Corporation, New York, N. Y.

Industrial Fuel Utilization in the United Kingdom,[1] by *W. A. MacFarlane*, National Industrial Fuel Efficiency Service, London, England

Changing Market Pattern for Solid Fuels,[1] by *George A. Lamb*, Business Surveys, Pittsburgh Consolidation Coal Company, Pittsburgh, Pa.

WOMEN'S PROGRAM

Thursday, October 25

8:30 a.m. Registration — **Franklin Room**

Orders for Technical Papers

ONLY copies of *numbered* ASME papers will be available. Some of these papers may not be available in time to permit your receiving them in advance of the Conference. Your order will be mailed only when the complete order can be filled unless you request that all papers available ten days before the meeting be mailed at that time. Please order only by paper *number;* otherwise the order will be returned. The final listing of available technical papers will be found in the issue of MECHANICAL ENGINEERING containing an account of the Conference.

Copies of ASME papers may be obtained by writing to the ASME Order Department, 29 West 39th Street, New York 18, N. Y. Papers are priced at 25 cents each to members; 50 cents to nonmembers. Payment may be made by check, U. S. postage stamps, free coupons, or coupons which may be purchased from the Society. The coupons in lots of ten are $2 for members, and $4 for nonmembers.

Copies of unnumbered papers, listed in the program, *are not available* because the review of these manuscripts had not been completed when the program went to press. The author's name and paper number will appear with paper title in the program, as well as the issue of MECHANICAL ENGINEERING containing an account of the Conference.

9:00 a.m. Coffee Hour **Franklin Room**

10:00 a.m. Tour of Rock Creek Park, viewing Embassies, with visit to Episcopal Cathedral, and then on to Normandy Farms, Maryland, for lunch

1:00 p.m. Luncheon at Normandy Farms

Friday, October 26

9:00 a.m. Coffee Hour

9:30 a.m. Tour of Washington, including Georgetown, Arlington National Cemetery, Lee Mansion, and Lincoln Memorial

1:00 p.m. Luncheon and Fashion Show **Shoreham Hote**

4:00 p.m. Tea at Pakistan Embassy

Authors' Breakfasts

The Authors' breakfasts will be held at 8:00 a.m. on October 25 and 26 in the Madison Suite

Applied Mechanics Division now should be sent to:

Technical Editors,
Journal of Applied Mechanics, ASME,
Division of Engineering,
Brown University,
Providence 12, R. I.

Drucker and Kestin Named Technical Editors of "Journal of Applied Mechanics"

On Oct. 1, 1956, technical editorship of the *Journal of Applied Mechanics* will be transferred from J. M. Lessells to D. C. Drucker and Joseph Kestin of Brown University. Dr. Drucker and Dr. Kestin, as technical editors of the Journal, will take over gradually the present duties of the Editorial Board of the Applied Mechanics Division of The American Society of Mechanical Engineers.

Professor Lessells will continue as Honorary Editor, assisting the technical editors in a consulting capacity. Since the establishment of the Journal, Professor Lessells has been technical editor. He brought to the quarterly the benefits of many years of experience as a practicing engineer both in England and in the United States. His interest in this professional journal in the applied mechanics field ran parallel with his teaching career at the Massachusetts Institute of Technology. He is himself the author of "Strength and Resistance of Metals" and coauthor of "Applied Elasticity." In 1938 he was editor of the Stephen Timoshenko 60th Anniversary Volume. Now he is president of Lessells and Associates, Inc., of Boston, Mass. Professor Lessells is Honorary Member of the ASME and holds membership in the leading professional societies both here and in England.

Daniel C. Drucker is chairman of the Division of Engineering of Brown University. He is the author of the chapter on three-dimensional photoelasticity in the "Handbook of Experimental Stress Analysis" and has had papers published on oblique incidence, birefringent coatings, impact, wire rope, metal cutting, plastic stress-strain relations, limit analysis and design, uniqueness and extremum principles, soil mechanics, instability, and brittle fracture. Before coming to Brown in 1947, Professor Drucker had been supervisor of mechanics of solids at Armour Research Foundation and taught at Illinois Institute of Technology and Cornell University.

Joseph Kestin is professor of engineering at Brown University. His fields of major interest are thermodynamics and fluid mechanics. One of his current studies in the accurate determination of viscosity is a part of the ASME Steam Properties Research Project which is to lead to an authoritative steam table to 15,000 psi and 1500 F. Author of many research papers, Professor Kestin also has translated Schmidt's "Thermodynamics," Schlichting's "Boundary Layer Theory," and Sommerfeld's "Thermodynamics." Before coming to Brown in 1952, Dr. Kestin was head of mechanical engineering at the Polish University College, London, England.

All papers to be sponsored by the ASME

D. C. Drucker, *left,* and Joseph Kestin, who were appointed recently technical editors of *Journal of Applied Mechanics,* discuss editorial plans

ASME Coming Events

Sept. 10–12
ASME Fall Meeting. Cosmopolitan Hotel, Denver, Colo.
(Final date for submitting papers was May 1, 1956)

Sept. 17–21
ASME Instruments and Regulators Division and Instrument Society of America Exhibit and Joint Conference, Coliseum, New York, N. Y.
(Final date for submitting papers was May 1, 1956)

Sept. 23–26
ASME Petroleum-Mechanical Engineering Conference, Conrad Hilton Hotel, Dallas, Texas
(Final date for submitting papers was May 1, 1956)

Oct. 8–10
ASME-ASLE Third Lubrication Conference, Chalfonte-Haddon Hall, Atlantic City, N. J.
(Final date for submitting papers was June 1, 1956)

Oct. 24–25
ASME-AIME Joint Fuels Conference, Sheraton Park Hotel, Washington, D. C.
(Final date for submitting papers was June 1, 1956)

Nov. 25–30
ASME Annual Meeting, Hotel Statler; National Power Show, Coliseum, New York, N. Y.
(Final date for submitting papers was July 1, 1956)

March 10–16, 1957
EJC Nuclear Engineering and Science Congress, Convention Hall, Philadelphia, Pa.
(Final date for submitting papers—Nov. 1, 1956)

March 18–21, 1957
ASME Gas Turbine Power Conference, Hotel Sheraton-Cadillac, Detroit, Mich.
(Final date for submitting papers—Nov. 1, 1956)

March 27–28, 1957
ASME Engineering Management Conference, Hotel William Penn, Pittsburgh, Pa.
(Final date for submitting papers—Nov. 1, 1956)

April 8–10, 1957
ASME Spring Meeting, Hotel Dinkler-Tutwiler, Birmingham, Ala.
(Final date for submitting papers—Dec. 1, 1956)

April 22–24, 1957
ASME Instruments and Regulators Conference, Northwestern University, Chicago, Ill.
(Final date for submitting papers—Dec. 1, 1956)

April 25–26, 1957
ASME Railroad Conference, Hotel Sheraton, Chicago, Ill.
(Final date for submitting papers—Dec. 1, 1956)

April 25–26, 1957
ASME Management-SAM Conference, Hotel Statler, New York, N. Y.
(Final date for submitting papers—Dec. 1, 1956)

May 19–23, 1957
ASME Oil & Gas Power Conference, Kentucky Hotel, Louisville, Ky.
(Final date for submitting papers—Jan. 1, 1957)

June 9–13, 1957
ASME Semi-Annual Meeting, Sheraton-Palace Hotel, San Francisco, Calif.
(Final date for submitting papers—Feb. 1, 1957)
(For Meetings of Other Societies, see page 895)

ASME Applied Mechanics Division Conference and Shock and Vibration Symposium Held at Urbana

The twentieth national Conference of the Applied Mechanics Division of The American Society of Mechanical Engineers was held on the beautiful campus of the University of Illinois at Urbana, Ill., on June 14–16.

About 250 registered for the Conference and attended sessions in two air-conditioned lecture rooms in Gregory Hall. Over 160 of those in attendance registered for the Shock and Vibration Symposium which had been arranged as a special feature of the Conference under the able direction of Charles E. Crede, Regional Vice-President for ASME, Region I.

The general technical program of the Conference contained 35 papers on topics ranging from important advances in the classical theory of elasticity to a detailed analysis of certain types of thrust bearings. A complete set of reprints of these papers was supplied to the conferees. In addition, 9 papers by authorities in the shock and vibration field were presented before the Symposium. All these papers were made available to those registered for the Symposium in a special publication of 188 closely printed pages.

The conferees were welcomed informally by Dean W. L. Everitt of the College of Engineering of the University of Illinois and Director of the Engineering Experiment Station at a dinner at Hotel Tilden Hall in Champaign on June 14. The principal social function of the Conference was a banquet at the Illini Union on June 15 with about 125 conferees and guests participating. The dinner was addressed by Prof. Royden Dangerfield, Director of the Institute of Government and Public Affairs of the University of Illinois. Professor Dangerfield presented a clear picture of the executive branch of the Federal Government with its various departments and agencies and the co-ordinating committees such as the National Security Council which have been set up to keep the whole immense apparatus in line with government policy.

Prof. Royden Dangerfield, director, Institute of Government and Public Affairs, University of Illinois, addresses ASME Applied Mechanics Division Conference banquet

Prof. R. D. Mindlin, Columbia University, chairman of the ASME Applied Mechanics Division, welcomes conference audience

The Conference Committee under the leadership of Prof. H. L. Langhaar planned and carried through the arrangements for the meeting without a hitch. The success of these arrangements was indicated by the full participation of the conferees in all Conference activities.

Thirty of the participants met at the Athenaeum, CalTech's faculty club, for the Applied Mechanics luncheon, which was highlighted by an informal address by Prof. R. D. Mindlin, National Chairman of ASME's Applied Mechanics Division.

This year's Conference, like those in 1954 and 1955, saw joint participation by the Applied Mechanics Division of The American Society of Mechanical Engineers and the Engineering Mechanics Division of the American Society of Civil Engineers.

ASME papers for the Western Conference are reviewed through the West Coast Committee in accordance with the same high standards maintained by the National Applied Mechanics Division and are published in the *Journal of Applied Mechanics*.

In June, 1957, the West Coast Committee will be hosts to the National Applied Mechanics Conference at Berkeley, Calif. Further information may be obtained from the Secretary of the West Coast Committee: Dr. D. S. Wood, California Institute of Technology, 1201 E. California St., Pasadena, Calif.

ASME Western Applied Mechanics Conference Meets on CalTech Campus

The 1956 ASME Western Applied Mechanics Conference of The American Society of Mechanical Engineers was held June 11–13 on the campus of the California Institute of Technology at Pasadena, Calif.

Approximately 75 registrants attended the three-day program, which included papers on dynamics, properties of materials and inelastic phenomena, plates and shells, nonlinear dynamics, and wave propagation.

Throop Hall, Administration building at the California Institute of Technology, Pasadena, Calif., scene of the 1956 ASME Western Applied Mechanics Conference

ASME Elects Fellows

The American Society of Mechanical Engineers has honored seven of its members by electing them to the grade of Fellow of the Society.

To be qualified as a nominee to the grade of Fellow one must be an engineer with acknowledged engineering attainment, have 25 years of active practice in the profession of engineering or teaching of engineering in a school of accepted standing, and be a member of the Society for 13 years. Promotion to the grade of

Fellow is made only on nomination by five Fellows or members of the Society to the Council, to be approved by Council.

The men whose outstanding contributions to their profession and to the Society who were so honored are:

Myron L. Begeman

MYRON LOUIS BEGEMAN, professor of mechanical engineering since 1938 and chairman of the department, 1947–1949 and 1953 to date, at the University of Texas, Austin, Texas, has an outstanding record in the field of engineering. A graduate of the University of Michigan, he was for several years a member of their mechanical-engineering staff. For eight years he was chief mechanical engineer for the Mississippi Glass Company where he assisted in the development of the continuous system of glass manufacture for that company. He obtained two patents in that field. As a teacher in mechanical engineering he has a prominent national standing as indicated by the several offices and committee memberships which he has held in national professional societies. His book, "Manufacturing Processes," which is in its third edition, has been used extensively in engineering colleges in the U. S. A. and abroad. He served as consulting editor on "Production Handbook," published in 1946 and is acting in the same capacity for the new edition. He has done extensive work with graduate students on various welding processes and with several types of metals, being concerned most with rapid welding processes, such as spot and seam welding. His publication record of numerous technical articles, some written with his students, shows the variety and scope of coverage of his work. He has done much work in the engineering-management and industrial-production areas and has encouraged a large number of graduate students to do their advanced work in these fields. He has promoted and helped develop a type of engineering shop-laboratory course which gives the student a broader knowledge of shop-production methods than was true for such work for many years. During World War II, a Lieutenant Colonel in the Ordnance Department, he served as Engineer Officer at the Southwestern Proving Ground. He also has served as research engineer in the Defense Research Laboratory, University of Texas, since 1946. Professor Begeman joined ASME in 1921 and was Director of the South Texas Section ASME on several occasions.

Ralph M. Ferry

RALPH MONTAGUE FERRY, who retired as manager of Tennessee Operations in May, 1955, rounded out an outstanding career cycle of almost 43 years with the Aluminum Company of America. He was employed by the company in 1912 and after four years of training, gaining experience in several departments, and assignment to specific jobs, was sent in 1916, to Toronto, Ont., Can. Six years later, having risen to superintendent of the plant, he was transferred to Edgewater, N. J., as superintendent of Edgewater Works. In the fall of 1929 he was transferred to New Kensington, Pa., as general superintendent and in the early 1930's became works manager. He was made manager of Tennessee Operations in 1945. While the three large plants at Alcoa, Tenn., were within the State as well as one hydroelectric power plant, two other hydroelectric plants which were a part of this unit, were located over the line in North Carolina. At the time Mr. Ferry was promoted to Fellow, ASME, he was cited for his development work which led to improvement of remelting furnaces, his work on a lacquering process for aluminum sheet, and his contributions to the first successful nonoxidizing annealing. He was also cited for his management experience and the size of some of the operations he supervised; particularly, under pressure of exacting demands for quantity and quality for military requirements; plus his interest in education and some of the successes he had had in developing younger men within the company. He has been a member of the Society since he joined as a student in his senior year, 1911–1912, at the Massachusetts Institute of Technology, he served as secretary of the Student Branch. In 1935 he was appointed to represent ASME on a subcommittee to prepare a "Code for the Prevention of Dust Explosions in the Manufacture of Aluminum Bronze Powder." In 1940 he was appointed as a representative of the ASME on the main committee for "Safety Code for Prevention of Dust Explosions, Z-12." In 1954–1955 he participated in the preparation of a code for presentation to the National Fire Protection Association entitled "Code for Prevention of Fire and Explosions From the Processing and Finishing of Aluminum and Aluminum Alloys —Including Processed Storage of Aluminum Powder and Paste." In the fall of 1930 he was one of the founders of the Western Pennsylvania Industrial Conference; serving at one time as general chairman, as a member of the board of governors for over 20 years, and presently as a member of the Advisory Committee to the board. He was one of the organizers, in 1931, and a charter member of the Alleghany Valley Foreman's Club, since renamed Industrial Management Club of the Alleghany Valley. From 1930 to 1945 he was a member of the board of directors of the New Kensington YMCA.

George A. Hawkins

GEORGE ANDREW HAWKINS, dean of engineering, Purdue University, Lafayette, Ind., has made wide contributions to the engineering profession both as a writer and as a professor. His teaching career at Purdue began in 1930. In 1936, he was named assistant professor of mechanical engineering, later progressively attaining the rank of associate and full professor. In 1953, Professor Hawkins was named dean of engineering. Among his duties as dean of engineering is the directorship of the Purdue Engineering Experiment Station. He is the author or coauthor of several leading textbooks on heat transfer and thermodynamics. He has also won recognition for his specialized work on viscosity, particularly of steam at high temperatures. He has carried on a considerable amount of consulting work in the area of his speciality. In collaboration with the late Dr. Max Jakob, he provided the teachers of mechanical engineering with a long needed textbook on heat transfer, at an elementary level suitable for undergraduates. From 1931 to 1940 Professor Hawkins worked with Dean A. A. Potter and Prof. H. L. Solberg of Purdue University on the subject of corrosion of alloy steels by high-temperature steam. Several papers covering this work have been published in the Transactions of the ASME. From 1941 to 1951 Professor Hawkins had charge of the Ordnance Research Program on the Purdue Campus. Purdue University was one of the first schools to be awarded the Ordnance Distinguished Service Award and he was personally given a War Department Certificate of Appreciation because of this activity. He was a member of the Main Research Committee of ASME from 1944 to 1948, also has been active in many of the committees of the Heat Transfer Division of ASME. He is currently serving as engineering consultant to the National Science Foundation and for five years has been ASME representative to the Engineering and Industrial Research Division of the National Research Council. Dean Hawkins wrote about 110 articles, abstracts, and discussions published in Transactions of the ASME, MECHANICAL ENGINEERING, *Applied Mechanics Reviews*, *Power*, and many other magazines. He is presently a Director of ASME assigned to Technology.

Warren C. MacFarlane

WARREN COURTLAND MACFARLANE, president of Minneapolis-Moline Company, has contributed substantially to engineering in the field of farm machinery. He is the author of several articles on agricultural mechanization and engineering education. In 1945, in recognition of his outstanding contributions in the field of mechanical engineering, Mr. MacFarlane was honored by the Minnesota Section of ASME, with special reference to his activities as business reorganizer and corporation executive. He was the recipient of a Special Industrial Safety Award, National Safety Council, in 1951; received a citation for meritorious services, National Scrap Harvest, 1942. Mr. MacFarlane was also presented with a Testimonial by the Army Ordnance Association in grateful acknowledgment of his services as a member of the association's Committee on Ordnance Endowment for the Scientific Advancement of Military Armament in the United States. He has been a member of ASME since 1919.

Frank L. Murphy

FRANK L. MURPHY, assistant vice-president, Pullman-Standard Car Manufacturing Company, Washington, D. C., has made valuable contributions in the field of railroad mechanical engineering. He joined the company in 1922, following graduation from Purdue University in mechanical engineering. Directed development work on air conditioning of railroad cars in the period 1931–1935. During the years 1935–1941, he was principal engineer in charge of railroad passenger-car engineering. This included the period of development of the

(*Continued on page 902*)

Junior Forum

Conducted for the National Junior Committee

by R. A. Cederberg,[1] Assoc. Mem. ASME

What Is a Professional Man?

By C. J. Freund[2]

THE eloquent skeptic spoke up: "Who cares, Professor, if we are professional or if we aren't? What difference does it make? What does it mean to be professional, anyway?" The professor gulped and blushed, and uttered one or two utterly futile platitudes. The students were elated, as they always are whenever one of them catches a professor off balance. The professor clearly came off second best, but how many of us engineers could have done better? (The eloquent skeptic has since become an extraordinarily successful structural-steel salesman; and he doesn't yet know, or care, whether or not he is professional.)

Of course, we are all proud of our profession, and we are quite sensitive about it. Just the same, though, our professional status is badly confused. We can prove our confusion right in the meetings of our Society, or in the pages of MECHANICAL ENGINEERING. A distinguished Society leader remarks in the course of an address that "if engineering is ever to grow to the stature of a real profession, we shall, have to. . ." And less than six months later a man of equal repute in the Society declares with force and conviction that "we shall fail to sustain the long established standing of our great profession and the regard for it in the American community, unless we. . ." When our head men are at odds, is it any wonder that some of us in the rank and file can't make up our minds whether we are professional or whether we aren't?

No Definition

We engineers don't know where we stand, for one thing, because there seems to be no gage whereby to measure our calling. There is no adequate definition of a profession. We engineers badly need a formal definition in order to clarify our status. Each of us, if he pretends to be conscientious, ought to do whatever he can to hurry the definition along. Most of us can't do much; we don't have the opportunity.

But if any one of us has a mental flash about something which belongs in the definition, he owes it to his fellows to tell them about it. Willard Chevalier had such a mental flash in 1937 in his speech before the National Council of State Boards of Engineering Examiners. He asserted that "ultimate technical responsibility" is the essential stuff which makes a profession what it is. In Chevalier's view, the truly professional man is the one who speaks the final technical word, and who is fully qualified to speak it. For instance, a village board retains a consulting engineer to design and supervise the construction of a pumping station for water supply. The members of the board are merchants, lawyers, bankers, and mechanics. They may discuss the output of the plant, its exterior appearance, its furnishings, or its cost. But they know nothing whatever about engineering, and they have no choice except to leave altogether to the engineer the design of the building, the selection and installation of motors, pumps, valves, and control equipment, and every other engineering aspect of the job. The consulting engineer himself carries the ultimate technical responsibility.

But the independent consultant is not the only engineer who exercises ultimate technical responsibility. Employed engineers likewise make final technical decisions. While a cooperative student I was oiler in the steam-power plant of an important machinery-building corporation. This corporation had undertaken to manufacture a line of heavy diesel engines, mainly for the propulsion of vessels. An experimental engine was being erected in the power plant adjacent to where I worked. The energetic and capable chief engineer of the corporation's diesel-engine division was in complete charge of the job. He was the only man in the organization who knew anything about diesel engines. One or the other of the officers and directors of the corporation were mechanical engineers, but they could do no more than come around every few days to observe progress. They could admire and wonder and ask questions, but they were quite unable to direct and supervise. This employed engineer had the ultimate technical responsibility. His employers were, in effect, his consulting clients.

C. J. Freund, Fellow ASME, dean, College of Engineering, University of Detroit

Pertains to All Professions

Ultimate technical responsibility seems to be the substance of professional standing, not merely in engineering but in all professions.

A dentist tells me that my tooth cannot be successfully treated and that it has to come out. I may go to another dentist, if I don't have enough confidence in the first one, but sooner or later I must yield myself to some dentist or other who will finally decide either that the tooth can be treated or that it has to be extracted. And I shall have to accept his judgment for the simple reason that I don't know anything about his business.

When Chevalier talks about "ultimate technical responsibility," he means to minister to uninformed, lay patrons, and to be fully competent so to minister. This pre-eminent qualification embraces high personal responsibility, intellectual activity, motive of service, and other characteristics of the professional man we have heard and read about again and again.

Technical Competence and Integrity

Now, how does the professional man, engineer or other, command the confidence of his uninformed client or employer? He commands confidence by his reputation for technical competence and for integrity.

We must recognize that it makes no difference whether or not a professional man actually ministers to dependent lay clients or employers. All that matters is that he is qualified to minister to them. It is the qualification, not the actual doing, which counts. Indeed, an engineer may actually be engaged in the real-estate business, or in the publication of a newspaper, or in retail merchandising; but he is unquestionably professional if his engineering competence and integrity are such that dependent lay patrons could readily trust him with important jobs.

We engineers have given precious little effective thought to integrity. It is true that scholars and statisticians have investigated us over and over, and each time ninety or more per cent of us have insisted that character—and by that we mean integrity—is the most important qualification of the engineer. On the other hand, though, examine the content of the mechanical-engineering curriculum from the freshman to the senior year; check through all the problems and exercises which the stu-

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[1] Westinghouse Electric Corp., Radio-Television Division, Metuchen, N.J.

[2] Dean, College of Engineering, University of Detroit, Mich. Fellow ASME.

dent has to turn in; look over all the extracurricular activities. You will find that ninety-five per cent of the whole is designed to develop the student's technical competence, and less than five per cent, if any at all, serves to strengthen his integrity.

After earning his degree, the young engineer sets out to get his experience. In an automobile plant he learns about research in metallurgy, the development of fuels, and the design of carburetors. Or he may get into process development or quality control. Now and then an old-timer may take him out to lunch and discourse upon professional integrity and responsibility. And he may hear an occasional lecture about engineering ethics, probably obscure and deadly dull. But the discourse or the lecture will be the exception rather than the rule, and the things that really matter are engines, suspensions, transmissions, and body styling.

Conformity; Not Mere Understanding

The engineer who writes examinations for registration in many of our states must answer questions to prove that he understands engineering ethics. But it is quite another matter to prove that he actually lives up to ethical standards. When the surgeon tells me that my arm has to be amputated, it is of no consequence to me that he understands the ethics of his profession. What I want to know, what I desperately want to know, is that ethics guide his actions; I want to be sure that he is not taking my arm off just to collect a big fee for doing the job.

We engineers are seriously concerned about our professional responsibility and integrity. But mere concern gets nothing done. Should we not require our students to study ethics in the colleges and schools of engineering? Should we not find a place for ethics in the postgraduation training and experience courses in our industries? Or if we insist that ethics should be learned in home, school, and church, should we not test applicants for admission to the colleges to be sure that they have learned their lesson?

Ingredients for a Definition

Engineers, other professionals, and even philosophers will keep on trying to formulate a completely satisfactory definition of a profession. Ingredients for a definition are gradually accumulating: individual responsibility, high intellectual activity, motive of service, and the like.

There may be flaws in my argument of which I am not aware. If there are none, we may propose still another ingredient for the definition!

Technical competence and integrity adequate to command the confidence of lay patrons. In fact, this ingredient may possibly comprehend most if not all the others.

And we can hardly avoid a secondary conclusion that it is rapidly becoming useless for us engineers and engineering educators to tell each other over and over, in speeches and otherwise, that our young men must learn to be ethical. Really, is it not time to do something about it?

Call for Agenda Items for 1957 RAC Meetings

THE 1957 Agenda Committee extends an invitation to every member of ASME to offer suggestions and improvements in the operations of the Society. This invitation is a step in the democratic process by which the membership and the Sections impart their ideas to the Council.

Please word your proposed items so that they are clear and specific and so that there will be no misunderstanding as to intent. Also, be sure the wording is positive so that action can be taken either to "approve" or "reject" the item as worded. Accompany each item with a short statement as to why you feel the item should be approved.

All agenda items are to be submitted in accordance with the following form, *and should be sent to the Secretary of your Section not later than October 1, 1956*. The Agenda Committee of each Section will screen these items against items previously considered by the Council, and forward the items to the National Agenda Committee not later than November 1, 1956.

If you lack the address of your Section Secretary, you may send your items, *not later than October 1, to the ASME Agenda Committee, 29 West 39th Street, New York 18, N. Y.*

ASME Agenda Item

PROPOSED BY..... of the .....Section

Address.....

Date.....

Item: It is proposed that

Proposer's Comment:

.....
Signature

E. G. Bailey to Address Combustion Control Conference in New England

THE New England Regional Conference on Combustion Control, under the sponsorship of Region I of The American Society of Mechanical Engineers in co-operation with the Northeastern Division of American Institute of Electrical Engineers, and New England sections of Instrument Society of America, will be held Friday, October 19, 1956, at the Norwich Inn and Country Club, Norwich, Conn.

The 18-hole golf course adjoining the Inn will be available to members and guests during the entire day.

Three plant inspection trips are scheduled and those who wish to partake of these visits are asked to provide their own transportation and carry proper identification. The trips include Middletown Steam Station of The Hartford Electric Light Company, Middletown, Conn.; Montville Steam Station, The Connecticut Light & Power Company, Uncasville, Conn.; and Pfizer Steam Station, Chas. Pfizer & Company, Groton, Conn.

E. G. Bailey, past-president and Fellow ASME, will be the principal speaker at the dinner. The subject of his talk is "Fundamentals of Combustion Control." John H. Van Vleck, dean of engineering, Harvard University, will preside and Charles W. Jewett, Lieutenant Governor of Connecticut, will extend greetings to the visitors.

The technical session, to be presented in two parts will start at 8:15 p.m. Paul V. Stevens, Montaup Electric Company and William H. Weaver, University of Massachusetts, will act as co-chairmen. Part one consists of a talk by Samuel C. Leland of Stone and Webster Engineering Corporation on "Application of Combustion Controls."

The second part, a symposium on "Operating Experience With Combustion Controls," will have 15 leading New England authorities as speakers.

The chairmen of the three committees in charge of planning the meeting are: John E. Bowker, of the General Committee; Dwight Douglass, Advisory Committee; and Herbert W. Hope, Attendance Committee.

Technical-Writing Societies Discuss Merger

A JOINT committee of members of the Society of Technical Writers (STW) and the Association of Technical Writers and Editors (TWE), two of the largest professional technical-writing societies, has been working on plans for a merger of the two societies into a single, nonprofit, professional organization. The initial plans call for a joint National Convention of STW and TWE to be held on November 15 and 16 at the Hotel Statler in

New York, N. Y. A new constitution will be presented to the joint membership for ratification and adoption after the National Convention. Merger of STW and TWE will result in an organization of over 1000 members in nearly every state in the United States and in Canada and with chapters in 20 cities across the two nations.

This merger will promote unity within the technical-writing profession by forming a single organization to represent all technical writers and editors. The goal of the combined group will be to aid in advancing the profession by such means as exchanging ideas, establishing standards, and encouraging the training of technical writers and editors.

ASME Codes and Standards Workshop

Nuclear Standardization

HARVEY WAGNER, Detroit Edison Company, has been named ASME representative on the ASA Planning Committee on Standardization in the Field of Nuclear Energy. He replaces F. S. G. Williams, Taylor Forge & Pipe Works, who will serve as alternate representative.

B5 Secretary

Hugh I. Knobeloch, Gardner Machine Company, has been appointed secretary of Sectional Committee B5, on Small Tools and Machine Tool Elements, replacing L. S. Dalcher, Fairbanks, Morse & Company. Mr. Dalcher had been named a B5 vice-chairman. (See page 593, June, 1956, MECHANICAL ENGINEERING.)

Life Tests for Single-Point Tools of Sintered Carbide

By O. W. Boston, Chairman of B5 TC21

This new ASA standard is just being issued to give test procedures to evaluate the wear characteristics as a function of cutting speed for sintered-carbide tools. The procedure is quite similar to that given for high-speed steel and cast nonferrous metal tools covered by ASA B5.19–1946. A tool of the given material and shape is set up to turn a particular material under constant conditions of depth, cut, feed, and cutting fluid. The wear on the tool is determined for each of several different cutting speeds, all other factors remaining constant for one tool, which gives an equation VT^n = constant. The slope n and the height of each line as measured for a given tool life are compared. In general, carbide tools wear by both flank wear and cratering. It has been found that the measurement of the flank wear as a function of cutting time represents a fairly good indication of the performance of the tool. The carbide tools should not wear as much as tools of high-speed steel, because when excessive wear, either face or flank, occurs, heat is developed which may cause the complete failure of the carbide by fracture. This ruins the tool. It is, therefore, desirable in practice to remove the tool before the wear becomes excessive so that it may be reground on both face and flank if necessary to recondition it. Normally, for commercial practice, a flank wear below the cutting edge of 0.030 in. is recommended for the period at which the tool should be removed for regrinding. For comparative test purposes, where material is limited, flank wear somewhat less, 0.020 or even 0.010 in., may be used. The standard outlines the preparations of the tools and the test procedure.

New Test Code for Ejectors and Boosters

By Philip Freneau,[1] Chairman, PTC Committee No. 24

A new Test Code covering steam-jet-air ejectors has been completed by the ASME Power Test Code Committee No. 24. This Code covers in detail the instrumentation and testing of this type of equipment both in the manufacturer's plant and at the installation in the field. While the main emphasis is on testing ejector equipment utilizing steam as the motive fluid, and air, water vapor, or a mixture of the two as entrained fluid, information for testing with other motive fluids and entrained substances is given.

[1] Chief project engineer, Southwestern Engineering Company, Los Angeles, Calif. Mem. ASME.

Philip Freneau, chairman, Power Test Code Committee No. 24

Need for an ASME Test Code for Ejectors and Boosters has been recognized for a long time and a selected group of engineers was organized in 1948 to start working on a code. The first meeting was held in September, 1948. At this meeting it was agreed that in order for this code to serve its intended purpose it would be necessary to work as closely as possible with the existing ASME codes and manufacturers' codes on steam-jet ejectors. This was accomplished by the addition to the committee of one member from the Heat Exchange Institute.

Many codes have been difficult to use because the scope of the code is not limited. This ejector code therefore is limited in scope in its first edition to apply chiefly to power-plant-type ejectors of single and multiple stages, with and without inter and after-condensers. For the present the code is specifically limited to ejectors in which the inlet pressure to be measured is greater than 0.25 in. Hg abs. This limitation will automatically be removed when suitable information on instrumentation and technique for measuring low absolute pressure has been approved and published in the supplements on Instruments and Apparatus.

Rules are included for adjusting test results to specific contract conditions for comparison with guarantees.

One method of testing ejectors includes testing the individual stages using atmospheric air as load while the condenser, if it is part of the unit, is tested separately. Another method, which some feel is preferable, is to test the entire unit and load the ejector with air-water vapor mixture from a tank partly filled with water. The water is heated to the saturation temperature and air is bubbled up through the water. These, as well as other conflicts, have been worked out without causing undue hardship on any person's testing facilities.

The main problems facing Power Test Code No. 24 were (1) to specify proper measuring flow nozzles for the small flows involved, (2) to define a method of metering motive fluid, and (3) to cover the effects of temperature and molecular weight on performance.

Battelle Memorial Institute assisted by making an investigation. The results were reported in two papers delivered at the 1950 ASME Annual Meeting. These two papers are: "Effect of Molecular Weight of Entrained Fluid on the Performance of Steam-Jet Ejectors," by W. C. Holton, Paper No. 50—A-114, Transactions of the ASME, October, 1951, pp. 905–910, and "Effect of Temperature of Entrained Fluid on the Performance of Steam-Jet Ejectors," by W. C. Holton and E. J. Schulz, Paper No. 50—A-115, Transactions of the ASME, October, 1951, pp. 911–913. The Technical Committee is also indebted to the Heat Exchange Institute for data on flow-nozzle coefficients and entrainment effect of temperature and molecular weight.

It is believed that in the test code these problems have been adequately solved and should materially assist in overcoming some of the difficulties in the art of ejector selection and testing procedure.

Policies on ASME Budget for 1956–1957

THE following statement of policies with the schedule of income and expense constitutes the Budget for 1956–1957.

1 A continuous effort will be made to collect dues.

2 No appropriation shall be made by Council without first referring back to the Finance Committee for recommendation. Before a liability is assumed the means for paying it shall be provided.

3 No new activity shall be undertaken without definitely showing that the funds required to support it will be available without decreasing the appropriations for existing essential activities, giving the consideration to the administrative expense that may be involved. When a new activity is authorized, if the additional funds to support it are not directly available from the unappropriated income, Council shall say what activity shall be curtailed or suppressed to permit transference of the funds required to support the new activity. If the budget of expenses is to be reduced, the Council shall say what activity shall be curtailed or suppressed.

4 The Society shall hold four general meetings with expense chargeable to the Budget. A fee shall be charged to nonmembers for admission to general or technical sessions at the four meetings of the Society according to rules established by the Board on Technology. No payments will be made for rental of rooms for the holding of technical sessions.

5 Council meetings shall be held at the place and time of the Annual and Semi-Annual Meetings. Council representation within the Budget shall be provided for the other national meetings.

6 Within the provisions of the Budget, Vice-Presidents shall be expected to visit Sections and Student Branches and attend Student Branch Conferences in their Regions or arrange for visits by their representatives.

7 No travel allowance will be provided for Board and Committee Chairmen attending

Combined Analysis of Expenditure Budget 1956-1957

Under Committee Supervision

PUBLICATIONS, STANDARDS, CODES, AND RESEARCH	Direct Expenditures	Joint Bodies	Members Travel	Printing & Distribution	Office Expense	Total
MECHANICAL ENGINEERING text pages (excluding student copies)				$116,500.00	$ 57,375.00	$173,875.00
MECHANICAL ENGINEERING advertising pages (excluding student pages)				$183,600.00	$166,904.00	350,504.00
Transactions (including *Journal of Applied Mechanics*)	$ 1,000.00			90,300.00	46,530.00	137,830.00
Membership List				10,000.00		10,000.00
"Know Your Society" (organization charts)				1,000.00		1,000.00
ASME Catalog				54,000.00	33,090.00	87,090.00
Publication Sales (except standards, codes, and research reports)				85,000.00	27,653.00	112,653.00
Standards and Codes		$ 1,500.00		80,000.00	102,759.00	184,259.00
Research				5,000.00	27,595.00	32,595.00
GENERAL SOCIETY ACTIVITIES						
Society Meetings	36,800.00				24,264.00	61,064.00
Sections (including Regional Administrative Committee of Regional Delegates Conference)	80,000.00		33,000.00		27,282.00	140,282.00
Professional Divisions	24,150.00				38,195.00	62,345.00
Student Branches (including Copies of MECHANICAL ENGINEERING text and advertising pages)	7,000.00		12,200.00	39,000.00	20,606.00	78,806.00
Admissions					22,349.00	22,349.00
Development					11,308.00	11,308.00
Awards	1,500.00				7,016.00	8,516.00
Civic Affairs Committee	500.00					500.00
GENERAL SOCIETY ADMINISTRATION						
Council and President	3,800.00		11,600.00			15,400.00
Professional Services	9,700.00					9,700.00
Public Relations	25,000.00				26,900.00	51,900.00
Nominating Committee			5,700.00			5,700.00
Retirement Fund	54,000.00					54,000.00
JOINT ACTIVITIES						
Engineering Societies' Library		16,900.00				16,900.00
Engineers' Council for Professional Development		3,600.00				3,600.00
Engineers Joint Council		9,000.00	700.00			9,700.00
Engineering Societies' Personnel Service, Inc. (reserve)		500.00				500.00
Registration (National Council of State Boards of Engineering Examiners)		500.00				500.00
UET Pension Fund		4,200.00				4,200.00
Council for International Progress in Management		500.00				500.00
INDIRECT EXPENSE						
Secretary's Office					52,343.00	52,343.00
Accounting Department					54,022.00	54,022.00
General Service (stores, mailing, filing, etc.)					117,581.00	117,581.00
General Office (rent, insurance, etc.)					76,146.00	76,146.00
	$243,450.00	$36,700.00	$63,200.00	$664,400.00	$939,918.00	$1,947,668.00

Council meetings except upon special provision of Council or the Executive Committee.

8 Eight Regional Administrative Committee meetings will be held within the provisions of the Budget.

9 A Regional Delegates Conference will be held at the place of the Semi-Annual Meeting.

10 The Nominating Committee may hold a preliminary meeting at a place to be selected and a Selection Meeting at the Semi-Annual Meeting within the provisions of the Budget.

11 The following uniform basis of contribution towards travel expense shall be adopted:

(*a*) For meetings of the Council, the Vice-Presidents (when meeting at some other time and place than the Council), the Nominating Committee, the Regional Administrative Committees, and the Regional Delegates Conference.

Thirteen cents per mile one way (calculated by standard railroad route) plus $6 per day or major part thereof for time engaged in business at meeting and for trips over 100 miles for travel time to and from the meeting not to exceed round-trip travel time by standard railroad route.

These payments will be made upon submission of a report on a form supplied by the Secretary.

(*b*) For Student Branch Conferences: To Faculty Adviser, 11 cents per mile one way (calculated by standard railroad route) plus $6 per day or major part thereof for time engaged in the Conference and for trip over 100 miles for travel time to and from the meeting not to exceed round-trip travel time by standard railroad route.

To Faculty Advisers in metropolitan area who do not travel over 100 miles, $6 per day or major part thereof for time engaged in the Conference plus a miscellaneous allotment of $3.

To the Student delegation, 18 cents per mile one way (calculated by standard railroad route).

NOTE: Payment for the Faculty Adviser and the payment to be used by the Student Delegates will be made in separate checks and sent to the Faculty Adviser. If the Faculty Adviser or his representative does not attend that check is to be returned.

(*c*) Visits of Presidents and Vice-Presidents or their designated representatives to Sections, Branches, and the like, out-of-pocket expense within budgetary limits prescribed.

12 Payments to the Sections for operation shall be on the basis of the Standard Formula plus 25 per cent.

The Standard Formula is: $3.50 per member for the first 75 members, $1.50 per member for the next 425, $1.25 per member for the next 500, $1 per member for all over 1000, and $150 to each Section for each authorized Subsection.

Supplementary payments equal to one-third of a dollar for each paid-up member in the Section on September 30; this supplementary payment to be made only on a specific request from the Section showing necessity for it, and with the approval of the Vice-President, the additional payment to be made with the second payment to the Section.

Any payments to a Section in addition to those paid on the Standard Formula shall require authorization by the Council.

Payments by the Section shall be made in accord with the Sections Operation Manual, and the Secretary's Staff has authority to deny reimbursement for payments not so made.

13 Payments to the Student Branches for operation shall be on the basis of: 15 through 50 Student Members, $25; for the next 50 Student Members, 50 cents per Student Member; and for all over 100 Student Members, 25 cents per Student Member.

14 Grants of Society funds for Section, Division, and Student Branch operations shall not be used for social events.

15 The Society shall have two representatives on the American Standards Association.

16 No publications shall be printed for sale unless there is reasonable assurance of sufficient orders to pay for the cost.

Engineering Societies Personnel Service, Inc.

THESE items are from information furnished by the Engineering Societies Personnel Service, Inc., in co-operation with the national societies of Civil, Electrical, Mechanical, and Mining and Metallurgical Engineers. This Service is available to all engineers, members or nonmembers, and is operated on a nonprofit basis.

In applying for positions advertised by the Service, the applicant agrees, if actually placed in a position through the Service as a result of an advertisement, to pay a placement fee in accordance with the rates as listed by the Service. These rates have been established in order to maintain an efficient nonprofit personnel service and are available upon request. This also applies to registrant members whose availability notices appear in these columns. Apply by letter, addressed to the key number indicated, and mail to the New York office.

When making application for a position include six cents in stamps for forwarding application to the employer and for returning when necessary. A weekly bulletin of engineering positions open is available at a subscription of $3.50 per quarter or $12 per annum for members, $4 50 per quarter for nonmembers, payable in advance.

New York	Chicago	Detroit	San Francisco
8 West 40th St.	84 East Randolph St.	100 Farnsworth Ave.	57 Post St.

Men Available[1]

Editor or Associate Editor, BSME; 35, graduate M.I.T. Published two books and wrote third on salary basis. Edited and published papers for company magazines; five years' industrial experience writing on power, heating and ventilating, or production articles. Desires eastern United States. ME-327.

Head of Manufacturing, BME, LLB, PE; 35; 12 years' diversified experience in design, development, product manufacturing, production control, and supervision of plant operations. Heavy automation experience. Aggressive, cost-conscious executive. ME-328.

Staff or Executive Engineer, outstanding in ability to correlate between scientific, engineering, production, and supplier organizations. Can assist top executive or administer group in mechanical and related fields. Broad coverage of light to heavy mechanical activities. 21 years' integrated management, development, research. Registered, advanced degree. ME-329.

Sales Engineer—Estimator, 36; BSME; PE; ten years' experience industrial structural-steel and steel-building products. Proved ability. Have car. Prefers northern N. J. ME-330.

Textile-Mill Manager or Superintendent, 51; BS; superintendent or manager of textile mills, 25 years specializing knitted goods production, especially tricot; experienced building and equipment construction and maintenance; machine shops; purchasing; labor and community relations; development, research, and testing. ME-331.

Professional Engineer, 35; industrial-mechanical, MSE, graduate study business administration; line and staff experience; industrial engineering, production, maintenance, metallurgy, cost control, and reduction. Desires administrative assistant or departmental administration. Prefers southern U. S. A. ME-332.

Positions Available

Materials Engineer, graduate mechanical or civil, minimum of five years' experience in materials work with petroleum or other process industry. Scope of activities will include structural materials, pipe, valves, fittings, gaskets, insulation, refractories, hardware, building materials, and other nonmachinery items. Will analyze service requirements, recommend suitable materials, methods, and techniques; review and evaluate new developments in materials included within scope of activities; investigate failures, difficulties, unsatisfactory performance of materials, etc. Salary open. Philadelphia, Pa. W-3714.

Engineers. (*a*) Development engineers, 25–45, graduate mechanical or equivalent, at least five to eight years' experience on mechanical or electromechanical equipment or components, including two or more years of development work. Senior Engineers will be responsible for direction of projects. Will write specs., prepare schedules and standards of performance, originate and lay out jury rigs and pilot models and tests thereon, etc. $6800–$10,000. (*b*) Machine designers and checkers, 25–40, with broad knowledge of technical machine design, machine-shop practice, manufacturing methods, and machine products. Will prepare scale layouts and assemblies; will develop intricate designs; check design drawings, etc. $6700–$9000. (*c*) Mechanical draftsmen, 20–40, with a broad knowledge of drafting techniques, technical machine design, shop practice, and manufacturing methods. Will prepare scale layouts, assemblies, etc. $3800–$7000. Company will pay placement fees. Brooklyn, N. Y. W-3718.

Manager of Plant Engineering, 35–45, to take charge of the design, supervise construction and major alterations, power systems, for manufacturing company with multiplant operations. $13,000–$15,000. Central N. Y. State. W-3727.

Purchasing Engineer, graduate mechanical, good engineering background in castings, screw-machine parts, electric components, for machinery manufacturer. $12,000. R. I. W-3730.

Methods Engineer, to direct methods-improvement program at multiproduct manufacturing organization doing a volume of 15 to 18 million per year. Will be in charge of methods group of six to eight people. Prefer someone who has had machine tool, tooling, standard costs, incentive. Salary open. Philadelphia, Pa. W-3740.

Engineers. (*a*) Project engineer, graduate mechanical, three to ten years' petroleum or chemical-plant experience, to assume responsi-

[1] All men listed hold some form of ASME membership.

bility for over-all project co-ordination and scheduling of engineering. Must determine scope, make contracts, prepare and edit specs. as required on capital, maintenance and experimental projects. To $8000. (*b*) Instrument engineer, graduate mechanical or electrical, three or more years' experience in chemical-plant-instrument design and development. Will design, write specs., specify equipment and handle startup problems for complete instrument installations in chemical-plant-operating units. To $8000. South. W-3747.

Remelt Engineer, 30–42, graduate mechanical, emphasis on training in heat transfer, fluid mechanics, and air handling; should have at least six years' experience in drafting, design, and junior engineering work in a remelt department. Should have gained some knowledge and experience in aluminum metallurgy, furnace construction and operation, and casting techniques. Salary open. Md. W-3750.

Operations-Standards Engineer, mechanical, civil, or industrial graduate, for administrative and management work on reviewing plans, better layouts, materials, estimating operational costs, maintenance schedules, etc. $6000–$9500. New York, N. Y. W-3766.

Engineers. (*a*) Equipment-design engineer, mechanical graduate, for the design of melting equipment and processing equipment to be used in the manufacturing of titanium mill products; two to eight years' of design work preferably in an organization designing steel-processing equipment required. $6600–$9600. (*b*) Production engineer, graduate mechanical or metallurgical, with one to five years' of general engineering, preferably in a production organization, to provide technical guidance in one of several plants where titanium is forged, rolled, or processed. Will monitor production schedule to insure that quality and delivery commitments are met. $5400–$9000. Company will pay one half of placement fee at time of employment and other half after six months; will pay travel expenses for interviews; moving expenses are negotiable. Pa. W-3773.

Mechanical Engineers. (*a*) Design and development, several years' experience in the design and development of precision electromechanical assemblies involving gears, cams, mechanisms, etc. Must be able to supervise layout men, handle all mechanical problems involved in the project. Previous experience in mechanical calculators, computers, switches, etc. desirable but not essential. (*b*) Design engineer familiar with the layout and design of precision-machine components and electronic packages. Must have two to five years' experience in the design of precision parts with at least two years' in a supervisory position involving control of design, layout, and detailing of complex equipment or components. $6000–$11,000. Company will pay placement fee. N. J. W-3775.

Chief, Plant Protection, 30–45, college degree or equivalent, engineering experience desired. A minimum of five years' experience in supervising and training personnel engaged in industrial plant-protection duties, with particular emphasis on fire protection. Will supervise four shift foremen, one fire inspector, and be responsible for fire protection, security, and building service. Salary open. South. W-3777.

Industrial Engineer, to head up an industrial department for a city with a metropolitan population of 30,000. Must have had some experience in industrial development work. Salary open. South. W-3781.

Senior Industrial Engineer, 35–45, for central administrative staff, to co-ordinate all management services including control, finance, product divisions for manufacturing company. To $12,000. Texas. W-3791.

Executive, for office appliance manufacturer, to 45, ME or degree in business administration, or both; experience in the manufacture and distribution of office machines with emphasis on building national dealer-distributor organization. Must have demonstrated ability and capacity in sales organization and administration. $25,000–$30,000 a year depending upon experience and past earnings. East. W-3794.

Assistant Labor-Relations Manager, 30–35, eight years' personnel experience, and three years in labor relations. $8400–$9500. N. J. W-3797(*a*).

Design Engineer, Valves, to 35, graduate, five years in valve and/or instrumentation engineering, for designing regulator valves, analyzing and answering sales-department requests for technical information; in short, top-level duties in the engineering department. $6000. Company pays placement fee and moving expenses. Ohio. W-3807.

Sales Engineer, to 35, college graduate, five years in the regulator, valve, steam, power, or process-equipment industries in sales; will do missionary work with representatives; some customer contact; some inside sales work such as correspondence, writing literature and bulletins, planning advertising, etc. $6000. Company pays placement fee and moving expenses. Ohio. W-3808.

Project Engineer, some administrative experience, graduate of a southern engineering school and experience in southern industry and construction; some experience in the construction of modern textile plants desired. Duties will include client contact and handling of large projects from the beginning, co-ordinating construction, architectural, electrical, and mechanical and all essential services. Salary open. South. W-3810.

Assistant Safety Supervisor, under 35, engineering degree desired but not required; with three to ten years' experience in industrial plants handling industrial safety problems. Will assist safety supervisor in promoting effective safety and housekeeping program; work in the plant, instructing supervision how to identify and eliminate mechanical physical hazards, etc. Salary open. La. W-3811.

Chief Engineer, graduate mechanical, managerial and administrative background, to head up a department of 120 engineers for manufacturer in the small engine field. $25,000–$35,000. Calif. W-3813.

Sales Engineer, under 40, mechanical or metallurgical engineering graduate, technical sales and steel-process-engineering experience, to sell furnace and processing equipment to steel mills. $6000–$10,000. Pa. W-3823(*a*).

Industrial Engineer for woolen and worsted mill, over 30, either an industrial, textile, mechanical, or electrical engineer; technical knowledge of spinning and weaving operations. Must be capable of installing and operating production planning, including process flow, scheduling material, etc., incentive and bonus plans, production standards, quality control, co-ordinate functions within the mill, etc. Some consulting experience is desirable. $10,000–$12,000. European Continent. F-3825.

Paper-Mill Production Expert, over 30, either industrial, mechanical, or electrical engineer, extensive practical experience in the production and management of paper mills. Must possess sound practical knowledge of all basic production equipment used in modern mills, including cylinder mills, as well as Fourdrinier mills, and the sulphate, sulphite, and semichemical processes of pulp production; qualified in the production and production processes of all types of paper board; possess a knowledge of machinery needs and layout of new mills, etc. One of the primary objectives of the study is to make the maximum use of the forest product, extending its usefulness through the economical utilization of reclaimed fibers. $10,000–$15,000, and up. European Continent. F-3826.

Lubrication Engineer, to act as field-service engineer; mechanical background desired. Duties will include customer servicing, lubrication specifications, and field surveys. Some travel. Midwest area. W-3831.

Administrative Tool Engineer, heavy experience in jig and fixture work and familiar with automatic screw machines, including Brown and Sharpe, Gridley, and Acme. Will supervise two to three tool designers or draftsmen. $6000–$8000. Conn. W-3832.

Project Engineers, graduate mechanical, experience either in the design, construction, or maintenance of process plants. $8000–$9000. Permanent. N. J. W-3836.

Thermodynamicist, BS or MS in a field which has offered strong thermodynamic courses, such as mechanical engineering, physical chemistry, and one to five years' experience in industrial research with application of thermodynamics. Specific responsibility will include cycle analysis for various refrigerants, heat-transfer, and thermodynamic properties of gases, liquids, and mixtures. $5500–$9000. Upstate N. Y. W-3837.

Editors. (*a*) Editor, mechanical or electrical-engineering graduate, with editorial and technical writing experience covering mechanical and electrical equipment. $8000–$9000. (*b*) Assistant Editor, mechanical or electrical, to prepare articles and assist editor. $5000–$6000. New York, N. Y. W-3840.

Engineers. (*a*) Power-plant engineer, young, mechanical graduate, power-plant maintenance and operation experience for process manufacturing plant. $5400–$6600. Ind. (*b*) Package-engineering assistant, mechanical graduate, machinery-design experience, for redesign and modification of packaging machinery. $6000–$7000. Northern N. J. W-3842.

Construction Manager, mechanical graduate, estimating, engineering, and supervisory commercial and military construction covering air conditioning, refrigeration, heating, plumbing, ventilating, process piping, power plants, and utilities for industrial plants and large commercial structures. Salary plus bonus. Fla. W-3843.

Chief Design Engineer, 30–40, mechanical or electrical graduate, at least five years' experience on design and layout of small indicating instruments of coil type, for industrial and military fields. Salary open. Conn. W-3844.

Sales Engineer, 25–30, graduate chemical or mechanical, approximately two years' experience in equipment sales for general sales work in eastern United States. Position involves discussion of design and construction details of high-temperature heating systems, dowtherm systems, fired heaters, crystallizers, mixing equipment, evaporators, high-pressure vessels, alloys vessels, etc. $6000. Headquarters, New York, N. Y. W-3845.

Design Engineer, Boilers, 30–40, graduate mechanical, over five years' experience in boiler design; experience in materials and thermal design. Will have charge of mechanical design of water-tube boilers in sizes to 100,000 lb per hr; supervise engineering and drafting departments of boiler division. $10,000. Pa. W-3846.

Plant Engineers, BSME, 23–30, two to six years' experience in preventive maintenance, preferably in petroleum refining or petrochemical field, for major petroleum refinery. Southwest. W-3847.

Manufacturing Engineer, under 45, graduate mechanical or industrial engineer, fully experienced in mass production of precision-metal parts. Duties will include technical supervision and co-ordination of production operations, including tooling, methods, cost, and quality control; supervision of foremen and production workers; supervision of plant maintenance. $9000–$10,000, plus liberal benefits. Newark, N. J. area. W-3850.

Field Engineer, young, mechanical graduate, to assist in application covering automatic steel-strapping equipment and eventually to assume sales and service responsibility in a midwest territory. Some strapping-sales experience desirable. Headquarters, New York, N. Y. W-3857.

Candidates for Membership and Transfer in ASME

THE application of each of the candidates listed below is to be voted on after Sept. 25, 1956, provided no objection thereto is made before that date and provided satisfactory replies have been received from the required number of references. Any member who has either comments or objections should write to the Secretary of The American Society of Mechanical Engineers immediately.

New Applications and ●Transfers

Arkansas

DOUGHERTY, RALPH W., Little Rock

California

ANDREWS, JOHN S., Los Angeles
ATKINSON, CYRIL P., Orinda
BUESE, SHERMAN F., Los Angeles
CARLTON, KIRKENDALL, San Mateo
DEAN, LEO E., Sacramento
FUCILE, ALEXANDER D., San Carlos
● HALLEN, GEORGE E., Long Beach
KAVANAU, LAWRENCE L., Glendale
MADISON, RAYMOND S., Glendale
MEDWADOWSKI, STEFAN J., Berkeley
MORGAN, PERRY L., Los Angeles
PETROZZI, PAUL J., Sacramento
ROCCO, ROBERT F., Garden Grove
● ROOS, ROBERT A., Downey

● Transfer to Member or Affiliate.

SELAK, PATRICK J., Oakland
• SHIPWAY, GEORGE D., La Mesa
STEWART, ROBERT F., Los Angeles
UNRUH, DELBERT C., Downey
ZELLERS, THOMAS R., Vernon

Colorado

CONNORS, ROLLIN J., Colorado Springs

Connecticut

LANZOLATTA, GERARDO J., Devon
REYNOLDS, EHRMAN S., Stamford

Delaware

GROPPER, FRED, Newark
JOHNSTON, JERROLD J., Newark

Florida

HILLS, WILLIAM H., Pensacola
• QUICK, GUY C., JR., Pensacola

Illinois

ALLISON, DONALD W., Hillside
BICK, KENNETH L., Morton Grove
OLD, FRANCIS P., Chicago
PROVENZANO, JOSEPH C., Skokie
RIEGEL, MALCOLM S., Chicago
RODDA, THOMAS A., Chicago
STEPHENS, FRANCIS E., West Chicago
TAYLOR, GEORGE W., Rockford

Indiana

BUCHANAN, MORRIS E., Columbus
DE CICCO, MICHAEL A., South Bend
DILLON, JACK A., Indianapolis
KEEFER, MARK A., JR., Fort Wayne
STAMBAUGH, DAVID J., Columbus

Iowa

• CROPPER, JOSEPH C., Cedar Falls
• HAUSRATH, ALFRED H., Ames

Louisiana

HUFFMAN, JOE D., New Orleans
LUSTED, EMILE W., Baton Rouge
ROCKWELL, JAMES L., Shreveport

Maryland

BERRETT, FRANKLIN E., Baltimore
• HABERMAN, WILLIAM L., Silver Spring
• HAEBLER, HERBERT J., JR., Baltimore
HILSENRATH, JOSEPH, Silver Spring
LESSIG, OSCAR I., Poolesville
TSAI, DONALD H., Silver Spring

Massachusetts

LANDER, GEORGE A., JR., Arlington
TABER, PHILIP, Marion

Michigan

COOPER, ROBERT M., Ann Arbor
JANEWAY, ROBERT N., Detroit
• KUNKLE, ROBERT G., Allen Park
• NUGENT, ROBERT L., Detroit
• ROTTY, RALPH M., East Lansing
TACHAR, JOHN J., Detroit

Minnesota

WEDEL, ERWIN, Minneapolis

Missouri

HOYER, FRIDTJOF S., University City
KEARNS, RICHARD B., St. Louis
• ROTTERSMANN, MAURICE H., Webster Groves

New Jersey

FORSTER, ERIC O., Linden
MOCHEL, GORDON C., Phillipsburg
SUTTON, PAUL A., Closter

New Mexico

• CLARK, ARTHUR J., JR., Albuquerque
WOLFF, WALTER P., Los Alamos

New York

ANDERSON, WALLACE J., Buffalo
BOSS, ILMARS G., Brooklyn
• BRADT, MORRIS, JR., New York
EVANS, SAM, New York
• GEORGE, HARVEY F., West Hempstead
• KENNARD, JARMAN G., Schenectady
KIRKPATRICK, JAMES W., Olean
LEDERER, EDWIN H., Syracuse
RAWE, ROGER F., Alfred
ROSS, PHILIP C., Utica
SIMS, ALBERT M., Garden City
SWENSSON, C. ERIC, Mechanicville
WEISER, JOHN B., New York
• WOODMAN, CHARLES J., Amityville
ZUBKOFF, MAURCIE J., Tonawanda

Ohio

ELDER, LOWELL L., Columbus
MENNITT, JOSEPH L., Toledo
STEIN, ROBERT A., Columbus

Oklahoma

ROADS, WILLFORD E., Tulsa

Oregon

MARTIN, RALPH W., JR., Eugene
SPARKMAN, JOSEPH B., Portland

Pennsylvania

• COIT, ROLAND L., Swarthmore
COVEY, LELAND S., Drexel Hill
• JOHNSTON, THOMAS L., New Castle
MCCLINTOCK, WARREN W., Philadelphia
MORSE, RICHARD H., North Wales
RUMBARGER, JOHN H., Downingtown
TOMLINSON, LEROY O., Philadelphia

Tennessee

AKERS, WALTER S., Elizabethton
• DUNHAM, ROY H., Knoxville
WOLFE, DANA F., Knoxville

Texas

• BEST, ROBERT D., San Antonio
• BROOKS, ROBERT C., Houston
LEBEAUX, JACOB M., Houston
MOSKOWITZ, ALFRED, Baytown
PLAPP, JOHN E., Houston
YEATS, JOHN R., JR., Houston

West Virginia

• BARNA, PAUL, Nitro
KING, WILLIAM F., JR., S. Charleston

Wisconsin

• BORCHERT, EDWARD W., Milwaukee
WELTMER, WILTON W., Milwaukee

Foreign

BAIN, ARCHIBALD M., Montreal, Que., Canada
CLOUGH, ROBERT L., Toronto, Ont., Canada
DULYANANT, CHAMRUN, Thonburi, Thailand
• MITCHELL, A. HOADLEY, Edmonton, Alta., Canada
TAYLOR, HARRY, Winnipeg, Man., Canada

Transfers from Student Member to Associate Member 222

Obituaries

Harold Baruch Bernard (1893–1956), retired, petroleum engineer and executive, Tulsa, Okla., died Jan. 30, 1956. Born, New York, N. Y., Dec. 16, 1893. Education, ME, Stevens Institute of Technology, 1914. He was a specialist in oil and gasoline production, engineering, and management. He contributed several articles to technical publications. Jun. ASME, 1915; Assoc.Mem. ASME, 1915; Mem. ASME, 1928. Survived by wife.

Carter Anderson Cole (1924–1956), efficiency engineer, Virginia Electric and Power Co., Richmond, Va., died Jan. 21, 1956. Born, Richmond, Va., Sept. 5, 1924. Parents, Oswald L. and Eva (Anderson) Cole. Education, attended Virginia Military Institute, 1941–1943; BME, University of Virginia, 1948. While serving in Germany with the Third Army, in 1945, he received the Bronze Star for heroic action. Married Marion Isobel Snead, 1950. Jun. ASME, 1948. Survived by wife and three sons, Carter L., William S., and George A.

Harold Charles Douda (1904–1955), Cleveland (Ohio) district sales manager, The Swartwout Co., died Sept. 27, 1955. Born, Cleveland, Ohio, Aug. 14, 1904. Parents, Charles A. and Mary J. Douda. Education, BS(ME), Case Institute of Technology, 1926; ME, 1927. Married Laverna Sayle. He specialized in power-plant equipment and the sale of automatic flow valves and controls, feedwater heaters, and separators. Mem. ASME, 1951. Survived by wife and two daughters, Nan (Mrs. C. O.) Bartlett, Jr., and Madge Douda.

Byron E. Eldred (1873–1956), physicist and inventor, died May 26, 1956, in Torrington, Conn. Born, Jackson, Mich., Feb. 12, 1873. Education, BS, Dartmouth College, 1896; hon. DSc, 1916. Dr. Eldred retired in 1941. In January, 1938, he had announced the development of a new method of casting metals through the use of latent heat. The process was sold to the American Smelting and Refining Company. He made the announcement on the occasion of his election as president of The Engineers' Club in New York. At that time he was referred to in a news story in *The New York Times* as "one of the few remaining scientists engaged in independent research of the type done by the late Thomas A. Edison." Another of his developments was an explosive called nitrobyronel, a name derived from his own. One of its features was that it required no fats or food products for its manufacture. In the early nineteen twenties, Dr. Eldred invented an instrument for curing deafness called the "auditor." The device met with considerable success in Great Britain. Among many commercial processes and products of which Dr. Eldred was the inventor were a substitute for platinum used extensively in the manufacture of electric lamps and electrical contacts; an optical light slit used in sound recording for motion pictures, and a "talking book" microphotographic record of sound. Dr. Eldred received the John Scott legacy and medal from the City of Philadelphia and the Elliott Cresson Gold Medal from The Franklin Institute. He was a member of the Executive Committee of the National Research Council in 1931 and 1932, and in 1929 was the United States Government delegate to the World Engineering Congress in Tokyo. Mem. ASME, 1903. Survived by wife, Mrs. Gurli Norden Eldred; a daughter, Mrs. Francis Stabler; three grandchildren; and eight great-grandchildren.

Robert Hugus Gaither (1879–1956), retired mechanical engineer, died May 12, 1956. Born, Meyersdale, Pa., July 15, 1879. Parents, James B. and Nancy (Hurst) Gaither. Education, special student, Stanford University, 1902–1905. Mem. ASME, 1918. From 1916 to 1921 he was stationed in Shanghai, China, as manager of engineering and acting agent for the American Trading Company. In 1923 he served the Whitin Machine Works in Japan and China and conducted a sales investigation in India. Seven years later, for Elliott Co., Jeannette, Pa., he investigated sales conditions in Chile and the Argentine. He spent the last ten years of his career, until 1953, in work with the Navy Department at Wilmington, Del., and New York, N. Y. Survived by three sisters, Emily O., Sara M., and Pauline; and one brother, Edwin H., Staten Island.

William Gray Goodeve (1921–1956), administrative engineer, General Motors Diesel, Ltd., London, Ont., Canada, died April 15, 1956. Born, Chatham, Ont., Canada, Dec. 26, 1921. Parents, William S. (deceased) and Winnifried (Haldane) Goodeve. Education, BS, Queen's University, Kingston, Ont., 1948. Jun. ASME, 1948. Married Mary Doreen Carruthers, 1953.

John Christian Graf (1886–1956), owner of John C. Graf Co., Philadelphia, Pa., died on March 31, 1956. Born, Philadelphia, Pa., July 18, 1886. Education, technical course in chemistry, Temple University, Philadelphia, Pa. Mr. Graf was for many years associated with hydraulic presses and special machinery with the old Southwark Foundry and Machine Co. of Philadelphia, which later merged with the Baldwin Locomotive Works. In the early nineteen forties, he became manager of the hydraulic and special machinery division of William Sellers & Co., Inc., until its liquidation. Following this, Mr. Graf started his own company, which has been and still is engaged in consulting, sales service, engineering, and design of custom-built hydraulic equipment. Mem. ASME, 1935.

Norman Gladding Hardy (1886–1955), retired, superintendent of power, Texas Power and Light Co., Dallas, Texas, died April 29, 1955. Born, Brooklyn, N. Y., June 6, 1886. Parents, John Bush and Minnie (Gladding) Hardy. Education, CE, Rensselaer Polytechnic Institute, 1910. Married Frances Hoyt, 1916. Mr. Hardy was connected with the Texas Power and Light Co. since 1922. Mem. ASME, 1919. Author of several technical papers which were published in professional journals. Survived by wife and three children, Elizabeth (Mrs. Vincent O.) Titterud, Dallas, Marian, Fort Worth, Texas, and Philip H., Cleveland, Ohio.

Raymond George Hastings (1897–1956), mechanical engineer, died April 28, 1956. Born, Weston, Mass., June 15, 1897. Parents, Isaac W. and Lura Althea (Dunn) Hastings. Education, ME, Tufts College, 1920. Married in 1922. Children, Parker W. and Beverley Anne. Mem. ASME, 1930. Survived by wife.

Robert Edwin Kennedy (1887–1955), assistant professor, Engineering Division, University of Illinois, died Aug. 7, 1955. Born, Vincennes, Ind., Aug. 4, 1887. Parents, Thomas and Margaret Ann Kennedy. Education, BS University of Illinois, 1925. Married Nellie R. Roberts in 1919. Children, one daughter, Alice E. Mr. Kennedy served on the general committee of Metals Engineering Division of ASME, 1946–1947. He received the Seamen Gold Medal from the American Foundrymen's Association in 1945. Mr. Kennedy contributed to several technical periodicals. Mem. ASME, 1921.

August J. Keuffel (1902–1956), professional engineer, died April 8, 1956. Born, Bremen, Germany, Jan. 11, 1902. Education, ME, Technische Hochschule, Dresden, Germany, 1927. Mr. Keuffel became a citizen of the U. S. A., April 18, 1955. He started his engineering career as design and calculation engineer on "Bauer-Wach" exhaust-steam turbine plants in Germany. He taught mechanical engineering at the Pratt Institute, Brooklyn, N. Y. In 1950, he entered the Worthington Corp., Harrison, N. J., as project engineer. Mr. Keuffel published articles in Germany and applied for a high-speed valve design patent in the U. S. A. Mem. ASME, 1954. Survived by wife.

John Markush (1927–1956), senior thermodynamicist, Republic Aviation Corp., died April 15, 1956. Born, New York, N. Y., July 13, 1927. Parents, Emery U. and Hedvig (Kiss) Markush. Education, SB(ME), Massachusetts Institute of Technology, 1950; M Math, Columbia University, 1953. Jun. ASME, 1950. Survived by father, a consulting mechanical engineer of New York, N. Y., and a brother, Dr. Robert E., Burlington, Vt.

George Ferguson McDougall (1873–1955), retired, president, Oregon Textile Machines, Inc., Portland, Ore., died March 24, 1955. Born, Superior, Mich., July 10, 1873. Parents, George and Sarah (Ferguson) McDougall. Education, principally private study supplemented by extension courses and lectures, Ann Arbor, Mich. Married Sadie Nelson, 1910; children, Robert and Phyllis. Mem. ASME, 1921. Mr. McDougall was a technical patent expert. Author of mining law of Oregon. He served on numerous committees for State of Oregon and City of Portland. He wrote numerous articles concerning patent systems and patent claims. Mem. ASME, 1921.

Albert Knox McMillen (1874–1952), retired, died in 1952. Born, Pittsburgh, Pa., Aug. 1, 1874. Education, Pittsburgh Schools and private tutors. Mr. McMillen was chief engineer with the Alex. Laughlin & Co. During his association with this company they designed and constructed open hearth furnaces for steel plants for the following: La Belle Iron Works, Lackawanna Steel Co., Milliken Brothers, Tennessee C. I & R. R. Co., Bethlehem Steel Co., Inland Steel Co., and Colorado Fuel & Iron Company. Mem. ASME, 1913. Survived by wife.

Victor Klifton Muzik (1899–1956), senior stress engineer, Hufford Machine Works, El Segundo, Calif., died May 28, 1956. Born, Prague, Czeckoslovakia, March 23, 1899. Parents, Jaroslav F. and Zdenka A. (Muzikova) Muzik. Education ME, University of Prague, 1921; English University, Prague; American School of Aviation, Chicago, Ill.; and Institute Espanol y Ihero-Americano, Prague; and Alexander Hamilton Institute, New York, N. Y. Married Martha S. Engebretson, 1946. He held a U. S. Patent on an airplane control. His Universal Coupling patent for automobile trailers bears a Czeckoslovak trademark. Mem. ASME, 1935. Survived by his wife.

William Burgess Senseman (1888–1946), Western manager, Combustion Engineering, Inc., Los Angeles, Calif., died April 10, 1956. Born, Scott City, Kan., June 4, 1888. Parents, Lemuel Clandenin and Catherine (Burgess) Senseman. Education, attended Kansas University, 3 years. Married Sue Pitkin, 1920; children, Mary Barbara and Hugh Burgess Senseman. Mr. Senseman held patents on pulverizing apparatus, dust collector, calcining gypsum, and mill drying process. Mem. ASME, 1927.

Elgin Stoddard (1869–1956), chairman of the board, C. C. Moore & Co., Engineers, San Francisco, Calif., died May 8, 1956 at the Peralta Hospital, Oakland, Calif. Born, Grass Valley, Calif., Oct. 12, 1869. Parents, Orlando and Harriet Elizabeth Stoddard. Education, graduated, Grass Valley High School, 1885; from 1888 to 1890 had special tutoring in higher mathematics with Knut Ljungman, graduate of a Swedish University with a degree in engineering. Married Julia Dahl, 1896 (died Feb. 9, 1939). Married 2nd, Minna Theresa Hoppe, 1943. Mem. ASME, 1911. Survived by wife, a resident of Piedmont, Calif.

Keep Your ASME Records Up to Date

ASME Secretary's office in New York depends on a master membership file to maintain contact with individual members. This file is referred to dozens of times every day as a source of information important to the Society and to the members involved. All other Society records and files are kept up to date by incorporating in them changes made in the master file.

From the master file are made the lists of members registered in the Professional Divisions. Many Divisions issue newsletters, notices of meetings, and other materials of specific interest to persons registered in these Divisions. If you wish to receive such information, you should be registered in the Division (no more than three) in which you are interested. Your membership card bears key letters, below the designation of your grade of membership and year of election, which indicate the Divisions in which you are registered.

Consult the form on this page for the meaning of the letters. If you wish to change the Divisions in which you are registered, please notify the Secretary's office.

It is important to you and to the Society to be sure that your latest mailing address, business connection, and Professional Divisions enrollment are correct. Please check whether you wish mail sent to home or office address.

Please complete the form below and mail it to: ASME, 29 West 39th Street, New York 18, N. Y.

Please Print

ASME Master-File Information

Date

LAST NAME | FIRST NAME | MIDDLE NAME

POSITION TITLE | NATURE OF WORK DONE
e.g., Design Engineer, Supt. of Construction, Manager in Charge of Sales, etc.

NAME OF EMPLOYER (Give complete name in full) | Division, if any

* ☐
EMPLOYER'S ADDRESS | City | Zone | State

ACTIVITY, PRODUCT, or SERVICE OF EMPLOYER; e.g., Turbine Mfrs., Management Consultants, Oil Refinery Contractors, Mfr's. Representative, etc.

* ☐
HOME ADDRESS | City | Zone | State

☐
PRIOR HOME ADDRESS | City | Zone | State

* CHECK "FOR MAIL" ADDRESS

I subscribe to

Address changes effective when received prior to:

☐ MECHANICAL ENGINEERING	10th of preceding month
☐ Transactions of the ASME	20th of preceding month
☐ *Journal of Applied Mechanics*	20th of preceding month
☐ *Applied Mechanics Reviews*	1st of preceding month

Please register me in three Professional Divisions as checked:

☐ A—Aviation	☐ J—Metals Engineering	☐ R—Railroad
☐ B—Applied Mechanics	☐ K—Heat Transfer	☐ S—Power
☐ C—Management	☐ L—Process Industries	☐ T—Textile
☐ D—Materials Handling	☐ M—Production Engineering	☐ V—Gas Turbine Power
☐ E—Oil and Gas Power	☐ N—Machine Design	☐ W—Wood Industries
☐ F—Fuels	☐ O—Lubrication	☐ Y—Rubber and Plastics
☐ G—Safety	☐ P—Petroleum	☐ Z—Instruments and Regulators
☐ H—Hydraulics	☐ Q—Nuclear Engineering	

Roundup

Of Current Engineering Events, News, and Comment

E. S. Newman, *News Editor*

Charles B. Jolliffe, *left,* vice-president and technical director, Radio Corporation of America, discusses technical manpower shortage with L. A. DuBridge, *center,* president, California Institute of Technology, as Dr. Irvin Stewart, *right,* president, West Virginia University, looks on

L. A. DuBridge Urges Calmer Approach to Scientific Manpower Situation

National Committee discussions air authoritative opinions

"I FEEL that a good many Americans are getting a little sick of hearing the argument that *we* must do this or that just because the Russians are doing it." On this note, Lee A. DuBridge, President of the California Institute of Technology, admonished the National Committee for the Development of Scientists and Engineers, at its West Orange, N. J., meeting, June 21, to give less attention to what Russia is doing and more attention to the needs of the United States.

"It is true," Dr. DuBridge stated, "that in Russia more men and women received degrees in science and engineering last year than in the United States. So what? Maybe that is because in the past 100 years they have so neglected their technical strength that they must now exert strenuous efforts to build it up. If this is true, then our rate of production should not be determined by their weakness—only by our own. Let us ask how many engineers *we* need to do *our* job, and not take over their figures for the numbers they require to do their job."

Noting that although the United States is now in short position with respect to numbers of well-qualified scientists and engineers, Dr. DuBridge foresaw a busy marketplace for future graduates in these fields. "It is perfectly obvious to me," he said, "that if we ignore temporary ups and downs, the long-term trend has been and must continue to be for an even larger fraction of our working force to be engaged in scientific and technical pursuits." He cited three factors contributing to the continued increased demand: (1) the technological age has just begun to arrive; (2) more research and development will be needed to produce more technological advances which will need still more trained men to manufacture, maintain, and use them; and (3) we are using up the easily obtainable supply of raw materials, and must dig deeper for our coal, iron, copper, oil, other materials, process low-grade ores, find and make new materials, develop new sources of energy, take care to obtain adequate supplies of fresh water and pure air.

Dr. DuBridge made a strong plea to the Committee to give emphasis to the quality of scientists and engineers. "Creative ideas," he pointed out, "occur in the minds of single individuals. Hence the pace of progress is determined by the quality of individuals rather than their numbers—and when quality is sacrificed for numbers, we may get weaker rather than stronger."

Dr. DuBridge spoke at the conference meeting of the National Committee—first of the two-day meetings held at Glenmont, home of the late Thomas Alva Edison, to which some 50 representative citizens had been invited. The Committee met in executive session on the following day. The Edison Foundation served as hosts to the Committee, which was established April 3, 1956, by President Eisenhower as an action group representative of major citizens' organizations concerned with education, training, and the utilization of scientific and engineering personnel. The two-day meeting was guided through its deliberations by its chairman, Dr. Howard L. Bevis, president of Ohio State University.

Clifford C. Furnas, Mem. ASME, Assistant Secretary for Research and Development, U. S. Department of Defense, who spoke at the morning conference session, warned that "our national security—in fact our very survival and that of the free world—depends upon maintaining a technological position that cannot be safely challenged until we devise some form of world organization or agreement between nations that will guarantee peace."

Herbert Scoville, Jr., assistant director of the Central Intelligence Agency, directed the attention of the Committee to the threat of Russian competition, pointing out that all Soviet high-school graduates receive five years of training in physics, five in chemistry, and ten in mathematics. He estimated that by 1960 USSR colleges will graduate some 155,000 students in all scientific fields as against an estimated 125,000 in the United States. "Knowledge, rather than understanding, however, seems to be the result of such education, and originality may be submerged," Dr. Scoville stated.

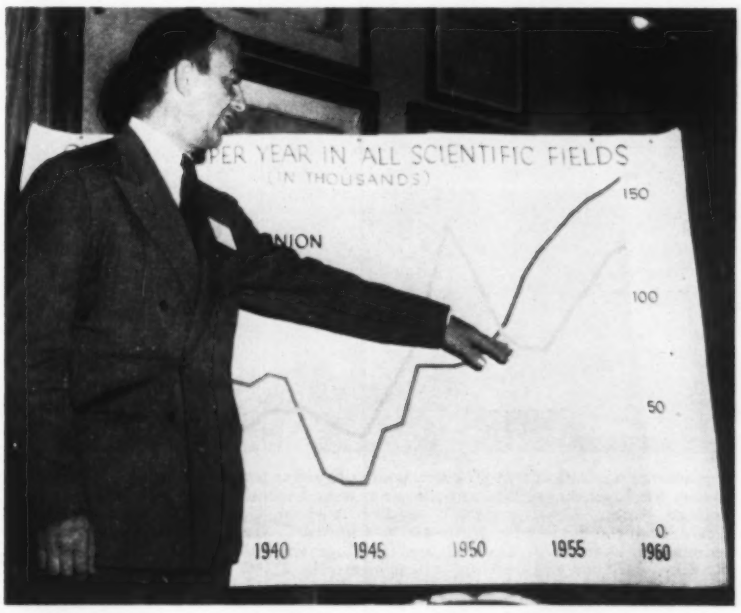
Other speakers during the conference session were Roy Blough, professor of International Business, Columbia University, who spoke on "The Expanding Domestic and World Economies as Generators of Continuous Requirements for Scientists and Engineers"; M. H. Trytten, director, Office of Scientific Personnel, National Academy of Sciences-National Research Coun-

cil, whose subject was "An Assessment of the General Trends in the Supply of Scientific and Engineering Manpower."

At the conference dinner meeting held in the Essex House, Newark, N. J., two case studies were presented on current and potential shortages. For electronics, the speaker was Charles P. Jolliffe, vice-president and technical director, Radio Corporation of America; and for chemistry, the speaker was George W. Beste, director of chemical research and development, Ethyl Corporation.

Dr. Jolliffe urged greater use of women in engineering and other science fields as one way to alleviate the current shortage. He said that in Russia about 20 per cent of the engineers were women, compared with one per cent in the United States.

C. C. Furnas, *extreme left,* Mem. ASME, Assistant Secretary of the Department of Defense, and a featured speaker at the National Committee for the Development of Scientists and Engineers meeting held at Glenmont, West Orange, N. J., is shown with, *left to right,* Charles Edison, honorary president, Thomas Alva Edison Foundation, host to the meeting; Howard L. Bevis, chairman of National Committee and president of Ohio State University; and Dr. Roy Blough, professor of international business, Columbia University



Dr. Herbert Scoville, Jr., assistant director, Central Intelligence Agency, makes a point in his talk on "Maintaining America's Technological Superiority" before the National Committee

ISO New Headquarters

The General Secretariat of the International Organization for Standardization has recently been moved to the International Centre, the address of which is 1, Rue de Varembe, Geneva, Switzerland. The cable address is ISORGANIZ.

Louis Polk Speaks on "Infinity in Action"

The advance in accuracy from the "thickness of a well-worn shilling," which was enough for James Watt's steam engine, to the millionths of an inch required today was described by Louis Polk, ASME Director, assigned to Codes and Standards, president of the Sheffield Corporation, Dayton, Ohio, and president of the National Machine Tool Builders' Association, in an address before the Vickers Second Production Machine Tool Hydraulic Forum, held in Detroit, Mich., recently at the Rackham Memorial Building.

As an example of "Infinity in Action," which was the subject of his talk, Mr. Polk cited "limitless progress in hydraulics, reaching out toward infinite precision, aided by new machine tools and measuring devices."

"Throughout all of the long tomorrows," he said, "we'll pursue the perfection that lies at infinity.

"During and after World War I we progressed gradually from thousandths to ten thousandths of an inch. During and after World War II, while production went to two or even one ten-thousandth, gagemakers went to twenty, ten, and in some cases even one and two millionths of an inch! But still greater production accuracy was demanded. On certain fuel-injection parts and ball-bearing assemblies, limits of plus or minus five millionths of an inch became standard. Gagemakers are now reaching for a tenth of a millionth of an inch.

"A millionth of an inch! It's almost impossible for the average nontechnical layman to grasp that infinitesimal concept. Take an inch of silver wire. Hold it in your hand for a moment, or just breathe on it. If you raise its temperature by even as little as one degree Fahrenheit, you will increase its length by ten millionths of an inch...not one millionth, ten millionths!"

Discussing the function of machine tools, Mr. Polk said: "We are living in an extraordinarily creative age. The impossible of yesterday becomes possible today and the reality of tomorrow.

"We shall achieve interplanetary travel. The chemist and physicist will develop new fuels. The metallurgist will develop new heat-resistant metals. The aerodynamicist will solve the problems of airless flight. The instrument specialist will devise the most complex navigational equipment. But no one will manufacture and apply these inventions without the help of machine tools—the true bedrock beneath the foundation of progress."

Where to Get Sorely Needed Engineering Manpower Focal Point of ASEE Meeting

EDUCATORS and industrialists gave voice to their ideas on the problems involved in supplying the nation with sorely needed engineering manpower during the American Society for Engineering Education annual meeting held recently at Iowa State College, Ames, Iowa.

More than 1300 registered to attend the meeting and participate in 57 conferences, 17 committee meetings, four general sessions, and 65 special luncheons, dinners, and breakfasts. They heard U. S. Senator B. B. Hickenlooper, who has served as chairman of the joint Congressional Committee on Atomic Energy, when he addressed the annual banquet on "Some Peacetime Uses of Atomic Energy." They elected officers and honored outstanding engineers and engineering educators.

They heard M. M. Boring, Mem. ASME, report that the country's technical colleges have lowered their standards and thus have contributed to the growing shortage of qualified engineers.

Dr. Boring, president of the ASEE said, "We have become hysterical concerning this manpower problem. We must all realize that merely adding numbers is not going to be the answer. The demands of industry clearly indicate that quality, rather than quantity, is really needed."

The difficulty in producing engineers who can cope with the demands of the atomic age begins in the public schools, he stated.

"During this century, our public schools have been forced into an educational program that is geared to the average youngster," he said. "The teaching of mathematics and science has degenerated enormously, as these subjects are no longer compulsory."

"Engineering colleges, too, have geared their program to the average student and have left the strengthening of the better students to the graduate schools," Dr. Boring asserted.

How to Improve Engineering Education

To correct these conditions Dr. Boring recommended this program:

Engineering colleges should stiffen their entrance requirements. This in turn would force primary and secondary schools to improve their standards.

Career guidance should be improved, beginning at the junior high-school level. At this point students who have decided on their futures are still young enough to take the proper courses to prepare them for college work.

Industries should contribute to encourage skilled engineering teachers to remain at their jobs instead of quitting to work for industry.

"Increased retainerships, more sponsored research, and the use of engineering teachers in off periods can pay big dividends in this matter," Dr. Boring stated.

Increasing Number of Engineering Students

The number of engineering students in the United States is expected to exceed 500,000 in the next 15 years, more than twice the number now in colleges. To meet this demand, a new program to instruct and retain engineering teachers must be developed immediately.

On the basis of a special study by engineering teachers at the University of Illinois, both the total number of college students and the percentage studying engineering are expected to rise sharply each coming year.

By 1969 a total college population of 4,550,000 is predicted. Of this number, at least 11 per cent, or about 501,000, will be engineering students. In 1955 there were 2,721,000 students in college. Of these, 8.8 per cent or about 243,000, studied engineering.

Technical colleges today face a double problem resulting from this situation, according to William G. Van Note, Mem. ASME, president of Clarkson College of Technology. First, a way must be found to stop the loss of engineering professors to private industry. Secondly, a program must be developed to encourage more young engineers to become teachers. At the core of both problems is the question of salaries, Dr. Van Note declared.

Automation

A bright picture for both the worker and the consumer in the coming age of automation was painted by an industrial executive. A. F. Vinson, vice-president for manufacturing services of General Electric Company, said that, as factories become more and more automatic, there is a demonstrated need for a work force of quality rather than quantity—for highly skilled technicians rather than a large population of unskilled labor.

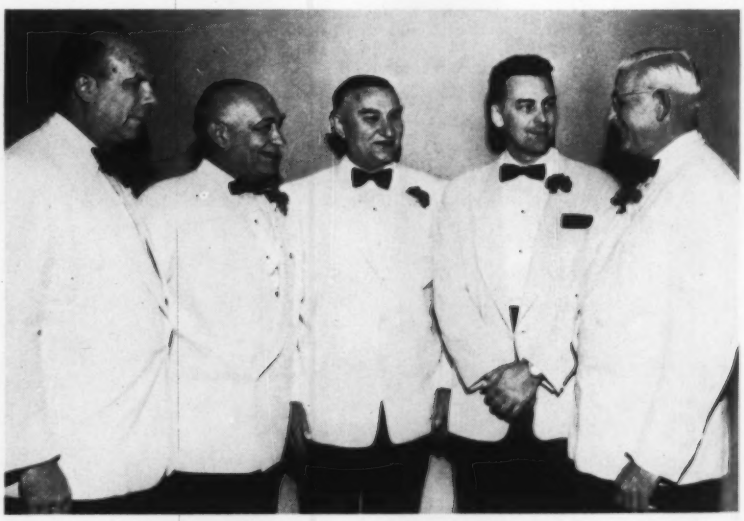
In describing new techniques for plant design, Mr. Vinson told how engineers no longer build the building and then put the machinery in it. They now design the most efficient production line and build a building around it. In some cases they do not even build the building. Outdoor plants are in operation at several points in the warmer parts of the United States and some are even being tried in northern areas.

Still lagging in the trend toward automation is production control—the paperwork and office area. But this area, he predicted also may be susceptible to better engineering.

Every engineering student today should know the fundamentals of nuclear science. Whatever he now thinks he will do after graduation, any student may find himself a "nuclear engineer" in tomorrow's broadening technology, according to V. Lawrence Parsegian, professor of nuclear engineering, Rensselaer Polytechnic Institute.

"The present tendency," he said, "to look on nuclear engineering as a separate professional subdivision imposes undesirable barriers and will impede its progress."

Already, he said, technical teams working on the major government and industrial atomic power programs include chemists, physicists,



Engineering education's 1956 honors went to these five members of the American Society for Engineering Education during its 64th annual meeting at the Iowa State College, Ames. *Left to right:* W. L. Everitt of the University of Illinois, elected president of the Society for 1956–1957; Clifford C. Furnas, Mem. ASME, Assistant Secretary of Defense for Research and Development, and winner of the first Vincent Bendix Award for engineering college research; L. M. K. Boelter, Fellow ASME, of the University of California at Los Angeles, Lammé medalist; Milton C. Shaw, Mem. ASME, professor of mechanical engineering at the Massachusetts Institute of Technology, winner of the George Westinghouse Award; and Maynard M. Boring, Mem. ASME, of the General Electric Company, and president of ASEE, who presided at the Iowa State meeting.

metallurgists, and almost every other type of engineer.

Dr. Parsegian concluded that the atomic program is likely to be the most important of the factors that will determine the pattern of engineering education for the next few decades.

The Scientist-Engineer

The World War II shotgun wedding of the scientist and the engineer has produced a good marriage, said Earl P. Stevenson, chairman of the Board of Arthur D. Little, Inc., speaking at a dinner meeting.

"Its offspring, the engineer-scientist of today," Dr. Stevenson said, "may turn out to be the most significant product of our age."

"When we talk about the scientist-engineer, we pay tribute to a revolution which has taken place," he said. "World War II catapulted scientists into engineering problems and engineers into situations where new knowledge had to be developed before a problem could be solved. To the amazement of both, this gunpoint wedding turned out to be stimulating and fun, as well as tremendously productive. It has proved a good marriage.

"During the war," he said "collaboration between scientists and engineers on atomic energy, guided missiles, rockets, fire control systems, and radar, was handicapped because scientists and engineers spoke such different languages. One of the greatest difficulties was that scientists and engineers insisted on using different units of measurement. Mathematics bridged the gap and has become the common language, and the first requirement of the engineer-scientist is that he be proficient in using mathematics as a real tool."

"The growing concern of engineers," he added, "with regard to research problems points up the need for engineering students not only to become familiar with the principles of the various fields of science and engineering and mathematics, but also to acquire experience in basic as well as applied research."

The National Science Foundation, he noted, the agency administering governmental research grants, reports that engineering research grants under the Division of Mathematical, Physical and Engineering Sciences are on the upswing. Only 3 of the 28 grants made by the Division in 1952 went to engineering science. That the quality of proposals for research in the engineering sciences has improved steadily since then is evident. In 1954 engineering proposals received 21 per cent of the grants made by the MPE Division.

"That basic research activity in engineering schools has been stimulated is indicated by the increase in proposals received for engineering research," he stated. "In the year just ending, requests have totalled approximately $3,750,000 for engineering research—more than the entire budget for the National Science Foundation in its first year of operation. In comparison, the Engineering Sciences Program had the total sum of $746,000 for fiscal 1956 available for grants, conferences, surveys, and other purposes."

"The need is great for more engineers," he concluded, "but the most critical need is for engineer-scientists. It is on this comparatively small group of well-educated, well-trained, creative individuals that our technical supremacy depends."

Officers Elected

William L. Everitt, dean of the college of Engineering, University of Illinois, was elected president of the ASEE on Tuesday, June 26. Raymond J. Woodrow, executive officer and secretary of the Committee on Project Research and Inventions, Princeton, University, was elected vice-president. Cleo A. Brown, administrative assistant to the president of the General Motors Institute, Flint, Mich., was elected vice-president for the society's instructional division activities. The new treasurer is John Gammell, Assoc. Mem. ASME, director of graduate training at the Allis-Chalmers Manufacturing Company, Milwaukee, Wis.

The new officers of the Mechanical Engineering Division include Eric J. Lindahl, Mem. ASME, University of Wyoming, chairman; Newman A. Hall, Mem. ASME, Yale University, vice-chairman; and D. L. Perkins, Mem. ASME, Wayne University, secretary.

Honors and Awards

The three highest honors in engineering education were awarded Thursday evening, June 28. They were:

The Lammé Medal, for contributions to teaching, research, administration, and the advancement of the profession, to Llewellyn M. K. Boelter, Fellow ASME, dean of the College of Engineering at the University of California in Los Angeles.

The Vincent Bendix Award, in recognition of outstanding contributions in engineering college research and its administration, to Clifford C. Furnas, Mem. ASME, Assistant Secretary of Defense for Research and Development. The Award, made for the first time, is named in honor of the founder of the Bendix Aviation Corporation; it was established last year by the Engineering College Research Council of ASEE.

The George Westinghouse Award, to a young engineering teacher for achievement in engineering, to Milton C. Shaw, Mem. ASME, professor of mechanical engineering at the Massachusetts Institute of Technology.

Engineering Societies Center—A Summary of the Facts

The matter of adequate quarters for the engineering profession has been under consideration for a long time, but more intensively during the past three years. During this recent period the actions of The American Society of Mechanical Engineers on the problem have been reported in Mechanical Engineering. However it may be desirable to summarize them:

A letter ballot of the members of the Society in April, 1954, by a vote of 16,279 to 939 approved "vesting in the Council the authority to decide for The American Society of Mechanical Engineers, at such time and place and in such manner as the Council may elect, such changes, if any, in Society headquarters' location as the Council may deem to be the best interest of the Society and in keeping with its dignity and traditions."

Five societies—American Society of Civil Engineers, American Institute of Mining, Metallurgical and Petroleum Engineers, American Institute of Electrical Engineers, The American Society of Mechanical Engineers, and the American Institute of Chemical Engineers—through Board action, agreed to work out the problem jointly.

In 1954 a committee of five—one from each society—made a four to one recommendation that the new Engineering Center be located in Pittsburgh, Pa. This recommendation was approved by only one board.

In June, 1955, the five societies received a communication signed by 21 leaders in engineering and industry throughout the United States and urged that a more careful study of the problems be made and gave assurance that a well-organized effort would be made to raise the necessary finances for a New Engineering Center at whatever place was decided upon in the careful study they suggested. Dr. Mervin J. Kelly, president of Bell Laboratories, Inc., was the leader in this movement and this letter is referred to as the Kelly letter.

In 1955 the five boards passed identical resolutions establishing a Committee of Fifteen to tackle the problem and providing funds for adequate staff support. This Committee was made up of leaders from throughout the United States: three from Texas, two from Ohio, two from Connecticut, and the others from Massachusetts, Indiana, Michigan, Louisiana, New York, Tennessee, and Delaware. ASME representatives on this Committee, three past-presidents, were: E. G. Bailey, whose home is in Pennsylvania, who heads a company domiciled in Ohio, and has an office in New York, N. Y.; James W. Parker of Ann Arbor, Mich.; and James M. Todd of New Orleans, La. Great care was taken to assure an unbiased committee.

The Committee engaged consultants and spent eight months in a study of previous reports, in consultation with a large number of interested individuals throughout the country and in visiting various cities. Eight cities were considered, but only four intensively: Chicago, New York, Philadelphia, and Pittsburgh. The Committee found that each of these had points in favor and points against. All four would provide a satisfactory site, but in each city, despite any local aid that might be provided, a large sum of money (about $2.5 million) was needed. The encouragement provided by the Kelly letter allayed the Committee's concern about the dollar problem regardless of the city. The deciding factors which dictated the Committee's decision to recommend New York were:

1 *Possible complications about Carnegie Fund.* The Attorney General of the State of New York threatened to file suit against taking

the proceeds of the Carnegie gift out of the city. The present building was a Carnegie gift.

2 *Relocation and termination problems.* Uniform programs for moving personnel to a new city plus the costs of moving long-time employees and terminating those who did not move, would cost somewhere between $200,000 and $500,000.

3 *The need for retaining space in New York.* Each society journal carries a large amount of advertising which would require the maintenance of representation in New York to work with the advertising agencies most of whom are centered in the City of New York.

4 *Training the replacement staffs.* The training of a large number of new employees in a new community would cause a decrease in effectiveness during a critical time.

The unanimous recommendations of this Committee of Fifteen, released June 27, 1956, (see August, 1956, issue of MECHANICAL ENGINEERING, page 773) are now before the five boards for action. There are about 130 men involved in this decision representing all areas of the country and all specialties in engineering. It will be well into September before the five actions are completed.

ECPD Annual Meeting Program in Detroit, Mich., Announced

THE twenty-fourth annual meeting of the Engineers' Council For Professional Development will be held October 25 and 26 at the Engineering Society of Detroit.

The Administrative Session at 3:30 p.m., October 25, the Executive Session at 9:00 a.m., October 26, and the Executive Committee Meeting at 5:15 p.m., October 26, are closed sessions. ASME members are urged to attend all other events.

The program as announced on August 10 is as follows:

THURSDAY, OCTOBER 25

9:00 a.m. **ESD Lobby**

Registration

Delivery of tickets for program events

9:15 a.m. **Hotel Statler, Parlor B**

Women's Assembly (Event A)

Assemble for conference registration and coffee

9:30 a.m. **ESD Auditorium**

Welcome to Detroit

Introduction: *Earnest Boyce*, ESD president

Speaker: *The Hon. Albert E. Cobo*, Mayor of Detroit

9:40 a.m.

The 24th ECPD Annual Meeting will be declared open by Thorndike Saville, ECPD president

10:00 a.m.

The First Five Years of Professional Development

Presiding: *George A. Porter*, chairman, Sponsoring Group, Detroit Industry Training Committee, and vice-president, Detroit Edison Co.

Addresses: *John J. Cronin*, vice-president, General Motors Corp.

Clement J. Freund, dean of engineering, University of Detroit

A. C. Monteith, vice-president, Westinghouse Electric Corp.

12:00 noon **ESD Banquet Hall**

Luncheon (Event B)

Presiding: *Thorndike Saville*, ECPD president

Speaker: *Kenneth McFarland*, educational consultant for General Motors Corp.

Women are invited to this event

1:45 p.m.

Panel Discussions: Points of the First Five Years of Professional Development Program and Their Application in Detroit

Panel on Orientation, Training, and Appraisal (Rooms E, F, and G, ESD)

Presiding: *Max W. Johnson*, general supervisor, Personnel Development, Engineering Division, Chrysler Corp.

Panel on Continued Education and Selected Reading (Junior Society Room, ESD)

Presiding: *Kenneth A. Meade*, director, Educational Relations Section, General Motors Corp.

Panel on Professional Identification and Integration Into the Community (Rooms C and D, ESD)

Presiding: *Howard P. Seelye*, engineering consultant, Detroit Edison Co.

2:00 p.m.

Women's Tour of Detroit Art Center (Event C)

3:15 p.m. **Auditorium**

Summary of Panel Discussions

Presiding: *Edwin L. Yates*, chairman, Detroit Industry Training Committee

3:30 p.m. **Room C and D, ESD**

Meeting of ECPD Council—Administrative Session. For members of Council and committee chairmen only

5:45 p.m. **Bagley Room, Hotel Statler**

Reception—Cocktails (Event D)

Hosts: Detroit Industry Training Committee

Women are invited to this event

6:30 p.m. **Wayne Room, Hotel Statler**

ECPD Annual Dinner (Event E)

Presiding: *Thorndike Saville*, ECPD president

Recognition of past-presidents, presidents of participating societies, and representatives of local engineering organizations

Presentation of Annual Report: *Thorndike Saville*

Address: *J. H. Foote*, president, Commonwealth Associates, Jackson, Mich.

Women are invited to this event

FRIDAY, OCTOBER 26

9:00 a.m. **ESD Lobby**

Registration

9:00 a.m.

Women's Excursion and Luncheon (Event F)

Assemble in Parlor B, Hotel Statler, prior to taking bus for tour and luncheon at General Motors Technical Center and tour of Cranbrook and Northland

9:00 a.m. **Rooms C and D, ESD**

Meeting of Council—Executive Session

For members of Council and chairmen of Education and Accreditation Committees only

9:00 a.m.

Open Meetings of Committees

Guidance: Conference Rooms E and F, ESD

Student Development: Conference Room A, ESD

Training: Conference Room G, ESD

Recogaition: Conference Room B, ESD

Ethics: Junior Society Room, ESD

Open Session—Ethics Committee

9:00 a.m. **Junior Society Room, ESD**

Discussion by the audience of four problems in Engineering Ethics; Formulation of Conclusions

Chairman: *C. J. Freund*, University of Detroit

1 Is it ethical for an engineering employer to pay salaries to his experienced engineers which are too low in comparison with salaries to recent engineering graduates?

Discussion Leader: *L. F. Grant*, Engineering Institute of Canada

2 When an engineer changes to a new employer, may he use information he has developed for his former employer if the former employer considered the information confidential?

Discussion Leader: *J. J. Uicker*, University of Detroit

3 A research engineer produces results by his experiments which are obviously valuable to the entire profession and to the industries. May he withhold publication of his results if his employer insists that he do so?

Discussion Leader: *S. L. Stolte*, Bettenburg, Townsend, and Stolte

4 A senior student has agreed to go to work for an employer following graduation. Is it ethical for him to reconsider, and to investigate another employer's proposition, particularly if the second employer will pay him $500 to compensate him for time and expense during the investigation?

Discussion Leader: *J. H. Foote*, Commonwealth Associates, Inc.

The other symposiums will be announced in the final program of the meeting.

12:00 noon **Banquet Hall, ESD**

Luncheon—Engineering Society of Detroit (Event G)

Presiding: *Thorndike Saville*, ECPD president

Speakers: *N. W. Dougherty*, dean emeritus, College of Engineering, University of Tennessee

1:30 p.m. Location same as for 9:00 a.m.

Open Meetings of Committees

2:30 p.m. **Auditorium, ESD**

Open Council Meeting

Presiding: *Thorndike Saville*

Presentation of reports as printed in the preprint of the 24th Annual Report

For the Standing and Special Committees:

Guidance: *K. F. Treschow*, ASME, chairman; secretary, Engineers' Society of Western Pennsylvania, Pittsburgh, Pa.

Education and Accreditation, *Harold L. Hazen*, chairman; dean, The Graduate School, Massachusetts Institute of Technology

Student Development, *N. W. Dougherty*, chairman; dean emeritus, College of Engineering, University of Tennessee

Training, *Edwin L. Yates*, chairman; Personnel Staff, General Motors Corp., Detroit, Mich.

Recognition, *George H. O'Sullivan*, chairman; electrical engineer, J. G. White Engineering Corp., New York, N. Y.

Ethics, *C. J. Freund*, chairman; dean of engineering, University of Detroit

Information, *Walter E. Jessup*, chairman; editor, *Civil Engineering*, ASCE, New York, N. Y.

Practice of Engineering (ECPD/EJC), *Charles Molineaux*, chairman; Authur J. Johnson Corp., New York, N. Y.

Engineering Profession Survey (ECPD/EJC), *M. D. Hooven*, chairman; electrical engineer, electrical engineering department, Public Service Electric and Gas Company, Newark, N. J.

Reports from Participating Societies

5:00 p.m.

Adjournment of 24th Annual Meeting

Address all inquiries regarding arrangements and tickets for program to: ECPD Annual Meeting Committee, Engineering Society of Detroit, 100 Farnsworth, Detroit 2, Mich.

AMF to Supply German University With Research Reactor

A CONTRACT was signed in New York, N. Y., June 20, at the German Consulate by AMF Atomics Inc., subsidiary of American Machine & Foundry Company, and the Federal Republic of Germany's State of Bavaria calling for the construction by AMF of a research reactor at Munich's Technische Hochschule for the training of atomic scientists.

Unprecedented in free Europe, it will be the first reactor to be installed at a university for training engineering students in nuclear science.

As approved for the West German government by Franz Joseph Strauss, the Federal Republic of Germany's Minister for Atomic Energy, the contract was signed at the German Consulate by General Walter Bedell Smith, president and chairman of AMF Atomics Inc., and H. Maier-Leibnitz, director of the Laboratory for Technical Physics at Munich's Technical University (Laboratorium fur Technische Physik der Technischen Hochschule Muenchen), for which the reactor will become a tool. Professor Maier-Leibnitz acted on behalf of the State of Bavaria which is purchasing the reactor.

"Technische Hochschule Muenchen" is one of Germany's leading advanced technological institutes. The reactor will be the heart of a new nuclear research center at the university which will permit broad expansion of nuclear science studies already being conducted there under Professor Maier-Leibnitz's direction.

"The installation of the reactor and the development of the nuclear research center which it will serve will be a most significant milestone in free Europe's peaceful atom program," said General Smith. "The specialized training the reactor will make possible will create a new supply of nuclear scientists which German industries will have access to in implementing their own nuclear research program."

Professor Maier-Leibnitz said construction of the one-megawatt "swimming-pool" type reactor is scheduled to start in October with July, 1957, as the "start-up" operation date.

Nuclear fuel for the reactor will be supplied by the United States government according to the bilateral agreement it has with the government of the Federal Republic of Germany to make the U-235 available in furtherance of the peaceful atom program.

It will be the fourth reactor to be built by AMF Atomics Inc. The company is currently completing a research reactor for The Battelle Memorial Institute of Columbus, Ohio, and has contracted to build similar swimming-pool type research reactors for the University of Buffalo and Industrial Reactor Laboratories, the first nuclear research facility to be privately owned and operated for industrial nuclear research. Ten of the nation's major industrial concerns will participate in this venture. In the power field, AMF Atomics Inc., will build a reactor for the Rural Co-operative Power Association of Elk River, Minn.

Nuclear Research Reactor, the first university installation in free Europe for the training of engineering students in nuclear science, was assured with the signing of a contract in New York, N. Y., June 20, at the German Consulate between AMF Atomics Inc., subsidiary of American Machine & Foundry Company, and the Federal Republic of Germany's State of Bavaria. Inspecting a scale model of the reactor are, *left to right,* H. Maier-Leibnitz, director of the Laboratory for Technical Physics at Munich's Technical University, where the reactor will be installed; General Walter Bedell Smith, president and chairman of the board of AMF Atomics Inc.; and Franz Joseph Strauss, the Federal Republic of Germany's Minister for Atomic Energy. The contract was signed by General Smith and Professor Maier-Leibnitz and approved for the German government by Mr. Strauss.

Meetings of Other Societies

Sept. 15–23
Royal Swedish Academy of Engineering Sciences and Swedish Association of Technical Physicists, fourth international Instruments and Measurements Conference, Sept. 17–19, and Exhibition, Sept. 15–23, Stockholm, Sweden

Sept. 16–22
American Society for Testing Materials, Pacific Coast meeting, Hotel Statler, Los Angeles, Calif.

Sept. 24–25
Steel Founders' Society of America, fall meeting, The Greenbrier, White Sulphur Springs, W. Va.

Sept. 24–28
Atomic Industrial Forum, 1956 Trade Fair of the Atomic Industry, Navy Pier, Chicago, Ill.; concurrently with forum on Management and Technology for the Atomic Industry, Sept. 25–27 Morrison Hotel, Chicago

Sept. 25–28
Association of Iron and Steel Engineers, annual convention, Cleveland Public Auditorium, Cleveland, Ohio

Sept. 26–28
National Physical Laboratory, international symposium on The Direction of Research Organizations, Teddington, England

Oct. 1–3
National Electronics Conference, Hotel Sherman, Chicago, Ill.

Oct. 1–3
Institute of Radio Engineers, Canadian convention, Toronto, Ont., Canada

Oct. 1–4
American Mining Congress, Metal Mining-Industrial Minerals Convention and Exposition, Shrine Exposition Hall, Los Angeles, Calif.

Oct. 1–5
AIEE, fall general meeting, Morrison Hotel, Chicago, Ill.

Oct. 2–4
National Association of Corrosion Engineers, South Central Region, Beaumont, Texas.

Oct. 2–6
SAE, national aeronautic meeting, Hotel Statler, Los Angeles, Calif.

Oct. 2–14
International Federation of National Associations of Engineers, second international engineers congress, Zurich, Switzerland.

Oct. 3
American Iron and Steel Institute, regional technical meeting, Thomas Jefferson Hotel, Birmingham, Ala.

Oct. 3–5
Standard Engineers Society, annual meeting, Hotel Willard, Washington, D. C.

Oct. 8–10
AIME, Institute of Metals meeting, Allerton Hotel, Cleveland, Ohio.

Oct. 8–12
American Society for Metals, national metal congress and exposition, Hotel Statler, Cleveland, Ohio

Oct. 8–12
American Welding Society, fall technical meeting, Cleveland Hotel, Cleveland, Ohio

Oct. 15–19
ASCE, annual convention, Hotel William Penn, Pittsburgh, Pa.

(ASME Coming Events, see page 879)

Henry Ford II, president, Ford Motor Company, is shown receiving the Society of Business Magazine Editors' first annual "Voice of Business" award in New York, N. Y. The award was presented to Mr. Ford in recognition of his "making the most substantial contribution to industry in 1955 in leadership, in business ethics, and in making it understood that most businesses are conducted with careful regard for the public interest." *Left to right* are: Frank Tighe, editor, *Motor Age;* Paul Wooton, Washington, D. C., newspaperman and chairman of the society's executive committee; Mr. Ford; Eldridge Peterson, editor, *Printers' Ink.*

D. S. Harder Reveals Exciting Future in Production at Ford Engineering Forum

A GLIMPSE into the future reveals exciting and unlimited possibilities in the development of new production techniques, new metals, and new uses for materials, D. S. Harder, Ford Motor Company manufacturing executive, said recently.

Mr. Harder, executive vice-president—basic manufacturing divisions, spoke on "The New World of Manufacturing" at the Ford Engineering Forum in Dearborn, Mich. Fifty engineering educators, representing 26 colleges and universities throughout the country, attended the Ford-sponsored meeting during the week of June 18.

Mr. Harder described several innovations which could significantly improve manufacturing processes for the automotive and other industries.

One research subject he noted envisages the use of a neutral white automotive paint containing photosensitive pigment, which could be colored by using a controlled electromagnetic radiation gun.

"When this becomes a reality," he said, "you could practically have the colors changed at will to suit the shade of your wife's new outfit. This paint would almost be self-cleaning. It would have the ability to actually expel dust and dirt from its surface when passed through an energy field."

Strides in improving the steelmaking process could lead to continuous casting of slabs as molten steel is taken from refining furnaces—eliminating several stages now necessary, Mr. Harder said.

"If we keep going forward in this progressive manner—which we must," he added, "I can visualize steel mills of the future located right next door to the iron mines, with the conversion of ore to steel becoming one continuous process."

The use of aluminum for such items as automotive radiators and applications of alloys and synthetic materials are being studied to save weight, conserve critical materials, and improve quality, Mr. Harder noted.

He said progress in automation, involving use of magnetic tapes to control machine tools, will enable greater quality production than ever before. He stressed, however, that such "electronic brains" will increase the need for technicians and more highly trained employees, and that fears of automation displacing masses of workers are unrealistic.

Other manufacturing ideas cited by Mr. Harder as holding great promise include pressure-molding of iron and steel into complicated and finished shapes; new plating alloys; cold extrusion—moving metal to form a part rather than removing it by machining; bonding techniques which involve magnetizing molecules of metals; electronic systems for moving materials and finished products within plants; and shipment of raw materials, such as coal, for example, hydraulically through pipelines.

Manufacturing plants of the future may not change radically in appearance, but many maintenance problems may be eliminated by use of stronger materials with greater rust and corrosion resistance, Mr. Harder commented. Other prospects include development of new sound-absorbing materials, conversion of the sun's energy into radiant heating for plants, and extensive use of television for such activities as guarding plant properties.

Everything that is "cast in the mold of the future" must contribute to greater efficiency, increased production, higher quality, and reduced cost, Mr. Harder said.

"Of course," he added, "we know we shall never really reach our manufacturing horizons. When we seem to arrive there, when all the things that now seem far away are accomplished, there will be a new horizon stretching out before us. But it is that fact that assures us that the manufacturing future is unlimited."

Coming Meetings

Petroleum and Middle East Situation

ENGINEERS who specialize in the production, distribution, and refining of oil and allied products, will get a first-hand account of the Middle Eastern situation during the third annual Electrical Conference of the Petroleum industry in the Muehlebach Hotel, Kansas City, Mo., Sept. 17-19. The conference is sponsored by the American Institute of Electrical Engineers.

The Middle East will be discussed by M. K. Neptune, of the Sahara Petroleum Company, Alexandria, Egypt, who will be the guest speaker at a luncheon Monday, Sept. 17. Title of his address is "Experiences and Impressions of the Over-all Middle East Situation."

Nine technical sessions, a symposium on transportation, a general session, a banquet, three luncheons and a number of field trips are planned during the three-day conference.

Naval Hydrodynamics

A SYMPOSIUM on Naval Hydrodynamics, sponsored by the Office of Naval Research (Mechanics Branch) in co-operation with the National Academy of Sciences-National Research Council, will be held in Washington, D. C., from September 24 through 28. This symposium—the first of a series to be held on a yearly basis—is an outgrowth of a continually growing need for meetings devoted exclusively to developments in the rapidly advancing field of hydrodynamics, particularly in the areas basic to Naval and marine applications.

Emphasis will be on critical surveys of these various areas, including identification of requirements for further research, to be presented by recognized authorities. An important aspect of these meetings is the stimulation of interest in research in classical hydrodynamics by making known more widely the many scientifically fruitful and technologically important problems extant. This first meeting will be unclassified and open to all those interested.

The program for the first symposium includes talks on boundary-layer stability, turbulence in shear flows, wave scattering due to turbulence, river waves, ocean-wave spectrum, free streamline theory and steady-state cavitation, physical effects in cavitation and boiling, hydrodynamics of underwater explosions, seaworthiness, hydrodynamics of

marine propulsion, ship-wave phenomena, hydrodynamic noise, hydrodynamics of water-based aircraft, basic hydroballistic phenomena, and hydrodynamic barriers in ship design.

Also scheduled is a tour of U. S. Navy laboratories in the Washington area.

Information on registration and other arrangements may be obtained by writing to Mr. John S. Coleman, National Academy of Sciences-National Research Council, Washington 25, D. C.

Perkin's Centennial

LOWELL Technological Institute, participating in the international 1956 observance of the Perkin's Centennial, will hold a three-day celebration, September 26 through 28.

During that period a lecture and display of rare books will be featured and at a special convocation honorary degrees will be conferred upon men famous all over the world in the fields of science, industry, and public service. Dedication of one of the newest buildings on the Lowell, Massachusetts campus will take place, and the program will culminate in an Open House on Friday, September 28, marking the first time since 1937 that such a public open-house invitation has been extended.

Twofold purpose of the affair is to show the public the tremendous growth and development of the Institute, particularly within the past decade, and at the same time to honor the late Sir William Henry Perkin, discoverer of the first synthetic dye—mauve—100 years ago, at the age of 18, while experimenting in a makeshift laboratory in the basement of his London home. Sir William himself was among the visitors to the campus, then the Lowell Textile School, 50 years ago.

Military-Industry Symposium

THE United States Air Force, in co-operation with all military services and the Department of Commerce, will sponsor the second joint military-industry symposium on Packaging and Materials Handling on October 9–11. The symposium will be held in the Departmental and Department of Commerce Auditoriums in Washington, D. C.

The exchange of information in a similar symposium held last year contributed greatly to a better understanding of military requirements for packaging and materials handling in a world-wide supply system.

This year's program is currently under development. Firms and individuals desiring to make suggestions should contact the Packaging and Materials Handling Division, Director of Transportation, DCS/M, USAF Headquarters, Washington 25, D. C.

Industrial Development

WINTHROP ROCKEFELLER will be the keynote speaker at Midwest Research Institute's Conference on Industrial Development, Friday, September 7. All sessions of the one-day meeting will be held at the Muehlebach Hotel, Kansas City, Mo.

Mr. Rockefeller, chairman of the Arkansas Industrial Development Commission, will speak at the luncheon, on "Industrial Development on a Planned Basis." Eight other outstanding speakers, at morning and afternoon sessions, will discuss various phases of industrial development, with emphasis on problems and opportunities for the medium-sized city.

"The middle west has hundreds of cities and towns which lie outside concentrated metropolitan areas," Charles N. Kimball, president of the Institute, said. "Their problems differ substantially from those of the big cities. As far as I know, this is the first time that an industrial development conference has been directed solely to the problems of the small and medium-size community."

For several years Mr. Rockefeller has lived at Winrock Farm, Conway County, Ark., where he participates actively in many civic enterprises. Since the Arkansas Industrial Development Commission was established, in April, 1955, he has served as chairman. Under his leadership the AIDC has made an outstanding record in stimulating medium-sized communities to devise new ways of assisting and attracting industry.

Featured in the morning session will be three papers describing "Significant Trends in Recent American Industrial Growth," "What Westinghouse Looks for in Plant Location," and "Selecting, Contacting, and Selling Industrial Prospects."

The afternoon session will be highlighted by such topics as "The Railroads' Role in Industrial Development," "Stimulating and Encouraging Local Industry," and "Applying Large-City Techniques to the Medium-Size City."

Two speakers from Midwest Research Institute will conclude the program with papers on "MRI's New Survey of Smaller Cities," and "Building Facts Into Factories."

Anyone interested can get further details by writing Industrial Development Conference, Midwest Research Institute, 425 Volker Blvd., Kansas City, Mo.

For the first time in its 38 years of existence, Members of Board of Directors and Branch Office Managers of Engineering Societies Personnel Service, Inc., convened in New York, N. Y., July 23–24, 1956, to discuss ways and means to meet the changing employment conditions in the engineering field. Standing, *left to right*, are: R. Gardner, AIEE; B. Allen, manager, Chicago; G. Parker, manager, New York; J. Decker, manager, San Francisco; O. B. Schier 2nd, ASME; E. J. Kennedy, AIME; P. Apol, AIME; J. A. Zecca, ASCE; E. Hartford, ASME; and F. McKinless, manager, Detroit. Seated, in the usual order, are: E. Kirkendall, secretary AIME; C. E. Davies, secretary ASME; N. Hibshman, secretary AIEE; A. H. Meyer, executive director ESPS; and W. Wisely, secretary ASCE. A number of important national policy changes in ESPS operations will be inaugurated as a result of this meeting and it is hoped that these changes will permit the Service to continue to serve the profession as it has done so well in the past.

VDE-VDI International Conference on Automatic-Control Program High Lights

THE program has been announced for the International Conference to be held at the University of Heidelberg, Sept. 25–29, 1956, under the auspices of the German Society of Electrical Engineers and the German Society of Mechanical Engineers (VDE-VDI). The theme of the conference is "Modern theories of automatic control and their applicability (to engineering problems)."

Most of the papers will be given by authors from outside of Germany. There are over 80 papers listed on the program by authorities from Russia, Japan, and several other countries. Also scheduled are authors from the United States. In addition to the Russians on the program, Professors Solodovnikov and Tsypkin from Moscow are expected to participate; as well as five Russians from the Institute of Automatic Control and Telemechanics. The papers will be presented by title with five minutes permitted for discussion of each paper. All of the addresses will be published

as papers in the German automatic-control journal entitled, *Regelungstechnik*.

The conference will be opened by K. Küpfmüller, who the Germans claim is the first man to have used closed-loop diagrams to represent control systems. Dr. Küpfmüller will greet the members. J. M. L. Janssen, who is in charge of instrumentation at the Royal Dutch/Shell Laboratory, Delft, Holland, will give his address on the theory and application of elementary techniques in the science of automatic control. Rufus Oldenberger, Mem. ASME, will then deliver the principal address.

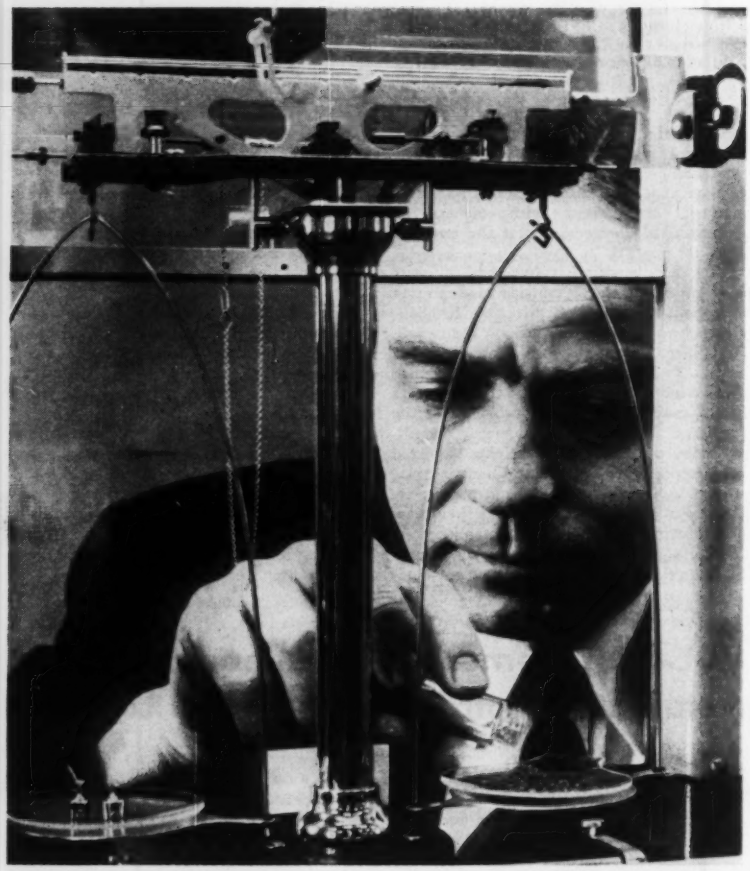
His lecture will be devoted to advanced aspects of the use of mathematics in the design of automatic controls.

The sessions devoted to discussions of papers will follow, with subsequent addresses by L. S. Dzung, Switzerland; B. P. Th. Veltman, Holland; and by H. Henning, M. Syrve, O. Kraemer, W. Oppelt, H. Sartorius, O. Schäfer, A. Leonhard, H. Schmidt, and R. Oetker of Germany; and J. E. Sampson of England.

The topics to be covered in the discussion at the conference include instruments and instrument engineers, the dependability of mathematical models for control systems, the state of automatic control in Germany, and the future of the automatic control field.

Smithsonian Institution Gets Cluster of Man-Made Diamonds

MAN-MADE industrial diamonds are now being produced in limited quantities at the Detroit pilot plant of General Electric's Carboloy Department.



One hundred carats of the first man-made diamonds produced in the pilot plant of G. E.'s Carboloy Department, Detroit, Mich., are being weighed here. J. S. Gillespie, manager of Carboloy's diamond project, weighed the industrial diamonds which have been mounted in a special plaque presented to the Smithsonian Institution in Washington, D. C.

This announcement was part of the ceremonies held in Washington, D. C., marking the presentation to the Smithsonian Institution of a cluster of General Electric's first man-made diamonds.

"Since 1954, when the first diamonds were made in the G-E Research Laboratory in Schenectady, N. Y., we have been making steady progress in bridging the gap between the first experiments and the production line," J. S. Gillespie, manager of Carboloy's diamond project, stated.

He pointed out that the two main areas of concentration are the production of man-made diamonds in quantity and at a marketable price. While progress is being made on both these problems, Mr. Gillespie stressed that there is "still more to be accomplished before we will have industrial diamonds commercially available."

The supply of industrial diamonds is essential to United States industry. In an emergency, it is possible that the source of natural stones, South Africa, could be cut off and, if this happened, many key industrial processes would be greatly handicapped. A domestic source of man-made diamonds, identical in every way to natural industrial diamonds, would help make this nation independent of the natural source, Mr. Gillespie pointed out.

He has estimated the industrial-diamond business as having a $200 million potential within the next decade—if the cost of the man-made diamonds can be brought down below those now being mined.

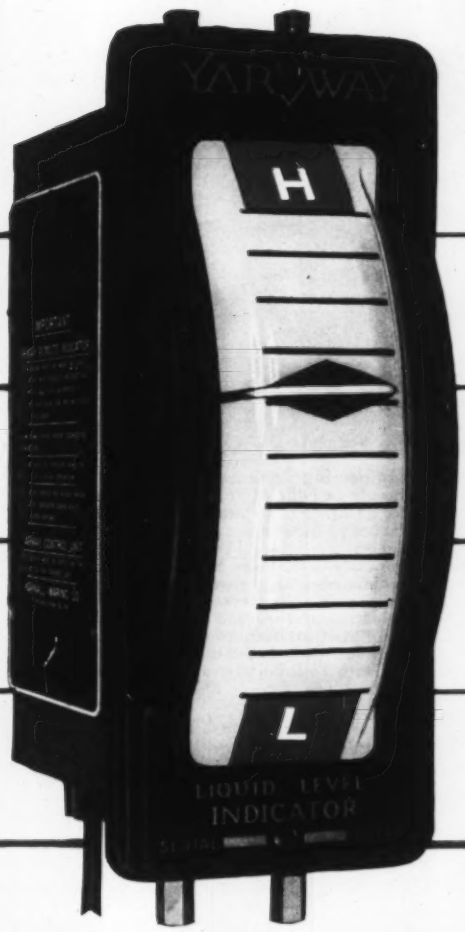
Much of this potential, according to Mr. Gillespie, is caused by the increasing demand for high production of interchangeable parts which must be held to very close tolerances. Diamonds are used for finishing these parts and for shaping and dressing grinding wheels that produce these tolerances.

"Commercial diamonds are now being consumed at the rate of 12 million carats a year. This represents a $50-million business," he said, "with about 80 per cent of these, by weight, going into grinding wheels, the balance in rock drills, wheel dressers, metal-cutting tools, and dies."

Management Conference

"MANAGEMENT and Organization Opportunities in Growth Countries" will be the theme of the First Inter-American Management Conference, which will be held in Santiago, Chile from Nov. 12 to 17, 1956. The conference will be sponsored by the Pan American Council of the International Committee for Scientific Management, of which the Council for International Progress in Management is the U. S. member. Leaders of American business, industry, and schools of business administration will contribute to the solution of such problems of international importance as increased productivity, expansion of markets, and the application of scientific methods in management—all fundamental to the successful economic growth of Latin America, and of particular interest to U. S. companies operating, or contemplating operations, in that area.

(Roundup continued on page 900)



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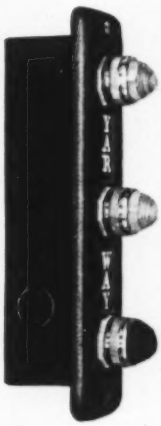

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Education

Pratt Announces Graduate Programs

PRATT Institute School of Engineering announces graduate programs leading to the degree of master of chemical engineering, master of electrical engineering, and master of mechanical engineering.

Courses are open to anyone qualified to benefit from them. Requirements for the master's degree, for qualified applicants: 30 semester credit hours including an acceptable thesis. Graduate programs are offered for both full and part-time students with evening courses for the convenience of employed engineers. Registration: September 17 to 21, 1956.

The following courses will be offered in the fall semester 1956–1957: advanced mathematics for engineers, operational methods in mathematics, vector analysis, advanced heat transfer, advanced thermodynamics, nuclear physics, and nuclear engineering.

For additional information, write to Director of Admissions, Pratt Institute, Brooklyn 5, N. Y.

MSU to Expand Engineering Facilities

MICHIGAN State University officials recently announced plans for a new College of Engineering on the south campus.

The project will be developed over the next five years at an approximate cost of $13 million.

The College of Engineering has asked for initial development of this site with buildings having a total area of 650,000 sq ft. This would provide facilities for a student body of 4000 engineering students, plus research activities, and an expanded graduate program.

The movement to the new site was made necessary because available land area surrounding the present engineering buildings, the major one of which was built in 1916, is not sufficient to provide buildings with enough floor space for the growing engineering enrollment.

Planning money for the first unit has been approved in the current session of the legislature. This unit will house the departments of mechanical engineering and applied mechanics. To be constructed at a cost of $4 million, the new building will provide housing of about 175,000 sq ft for the two departments now most seriously limited by space and increased enrollment.

The second unit in the five-year development will be the civil-engineering and engineering-drawing building. Included in this construction of 100,000 sq ft will be a separately financed wing to house the research laboratory of the state highway department now occupying space in the basement of Olds Hall.

The last two buildings to be added to the development of the site, under the present plan, will house the electrical-engineering department and research activities of the engineering college with approximately 150,000 sq ft. Another unit will house the chemical and metallurgical-engineering departments with about 100,000 sq ft.

View shows new mechanical-engineering design and research laboratory recently opened by the New York University College of Engineering. Reconstructed from an existing building at the cost of $100,000, the laboratory houses machinery valued at about $300,000. There are facilities for instruction of students in machine-design and manufacturing-process courses, mechanical-engineering research apparatus, and the NYU regional gage laboratory of the New York Ordnance District. Other units include motion-picture projection and lecture room, drafting room, casting section, grinding section, reading room and reference library on production processes, and offices. The 6000-sq-ft laboratory was designed by Fred H. Posser, Assoc. Mem. ASME, associate professor of mechanical engineering and director of the gage laboratory. It has about 125 pieces of motorized equipment, including a specially designed research lathe with an infinitely variable speed range.

Applied Meteorology

A BROAD program in applied meteorology that touches upon a wide range of activities in many fields has been introduced at The University of Michigan's College of Engineering, Ann Arbor, Mich.

The program deals with meteorology as it applies to engineering, medicine, agriculture, architecture, conservation, and a host of other areas.

Eleven courses in meteorology and the master's degree are now offered and research projects involving specialists in engineering, medicine, botany, ecology, biochemistry, and public health are in progress.

The program answers a need for education and research in applied meteorology in the face of a growing awareness of the vital roles that weather and climate play in almost every area of human endeavor.

Typical of the broad research projects under way or projected is a five-year study of air pollution by aeroallergens under the auspices of the National Institutes of Health, with emphasis on scientific studies on the production, release, distribution, and medical effects of ragweed pollen.

Requests for further information concerning the graduate-degree program should be addressed to E. Wendell Hewson, Professor of Meteorology, University of Michigan, Ann Arbor, Mich.

Literature

Atomic Energy

FOUR books were published recently by the U. S. Government Printing Office, which should prove of great value to engineers and scientists as well as present some much-sought-after information on Russian research in the field of atomic energy.

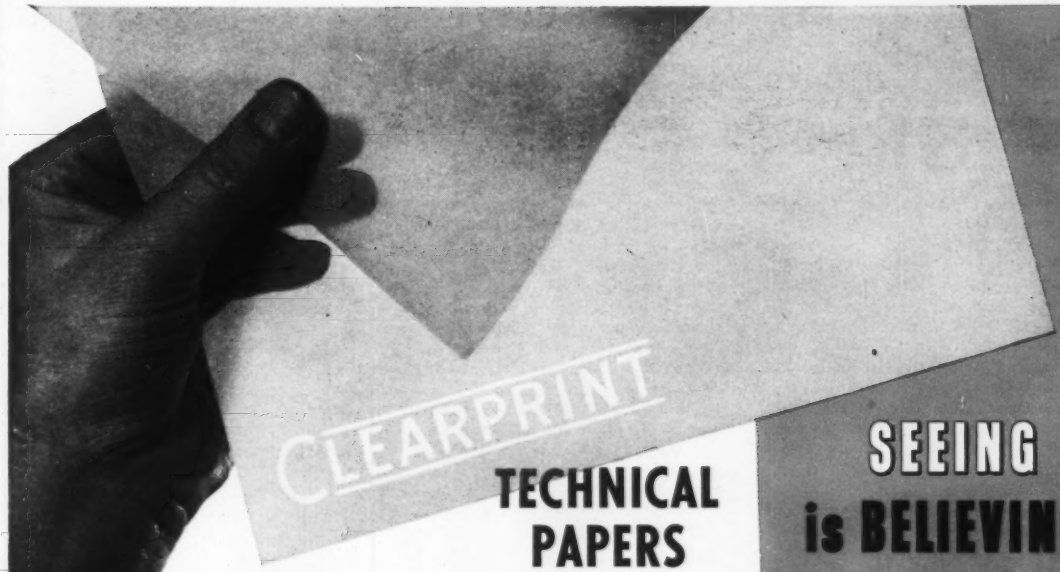
In English translation, the books cover the Conference of the Academy of Sciences of the USSR on the Peaceful Uses of Atomic Energy, July 1–5, 1955, a month before the United Nations Conference was held in Geneva. The books are available from the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C.

Introductory remarks by A. N. Nesmeyanov, president of the Academy, and 23 papers presented at the session of the Division of Physical and Mathematical Sciences, complete the first book. Paperbound, illustrated, $8\frac{1}{2}$ x 11 in., and more than 259 pages, it is priced at $1.25. The other three companion books, also paperbound, are priced at $1 each, cover the sessions of the divisions on technical science, chemical science, and biological science.

EJC Assembly Proceedings

A DISCUSSION of the Reserve Forces Act of 1955 by top representatives of the Selective

(*Roundup continued on page 902*)



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Service Department of the Department of Defense, Office of Defense Mobilization, and the findings of the Hoover Commission of interest to all engineers, are two high lights of the material compiled in "Proceedings—Second General Assembly" of Engineers Joint Council. ASME is one of the constituent societies of EJC. The summary is available at Engineers Joint Council, 29 West 39th Street, New York, 18, N. Y., for $1.

The 68-page pamphlet contains not only the formal talks at the Engineers Joint Council General Assembly held in New York, N. Y., Jan. 26–27, 1956, but also reports the questions and discussions from the floor during the several meetings in the two-day conference. "Brainpower—Our Greatest Asset" is the title of a comprehensive report by Frank H. Bowles, director, College Entrance Examination Board, of some of the solutions to the current crisis in engineering and science education.

Nine representatives of industry report on various methods for extending the usefulness of the engineer in their several companies by appropriate methods in using balanced teams of engineers and technicians. The address of Walker L. Cisler, Fellow ASME, president of Detroit Edison Company, "A World Look at Usefulness of Nuclear Power," which concludes the pamphlet, is notable for its scope in summing up what can be expected in the atomic-energy field.

Nuclear Science and Engineering

THE first issue of *Nuclear Science and Engineering*, the official journal of The American Nuclear Society, was released in March, 1956.

The journal is to be devoted to the presentation of theoretical and experimental papers relating to such subjects as nuclear-reactor design, construction, operation; interaction of nuclear radiations and matter; basic phenomena in performance of nuclear fuels; production, uses, and disposal of radioactive materials; chemical processing of nuclear fuels; basic and applied neutron physics; heat-transfer problems peculiar to nuclear reactors; technology of reactor materials; radiological safety, health physics, nuclear-radiation shielding; nuclear-instruments research and development; reactor and fission physics; systems for remote handling of radioactive materials; nuclear-reactor stability and control; controlled release of energy from nuclear fusion.

J. G. Beckerly, Schumberger Well Surveying Corporation, Houston, Texas, is editor.

Published bimonthly by Academic Press, Inc., 125 East 23rd Street, New York 10, N. Y., six issues cost $10; single issues, $2. Subscriptions should be sent to the publishers.

Nuclear Engineering

A NEW British journal, *Nuclear Engineering*, commenced publication with its April, 1956 issue. A journal of international appeal, it will cover every phase of world industrial production and utilization of nuclear energy and its by-products. Regular and original contributions from leading authorities on these subjects will be published, as well as news of industrial significance.

The extensive editorial scope of this new industrial journal is illustrated by the following partial list of subjects on which articles will be published from time to time: Power supplies and economics; public health; nuclear-fuel supply; nuclear-reactor fuels; nuclear reactors; chemical processing; radiation shielding; supply and treatment of special materials; heat transfer; isotopes; nuclear-engineering education and training; and special techniques of nuclear engineering.

Regular monthly features will include: News of contracts, industry and trade, patents, new equipment and processes, lectures and courses, and movements of personnel.

E. N. Shaw, who has, since 1953, been head of the Research Department, Isotope Developments, Ltd., is editor. He will have available to him the advice and active assistance of consultants in the field of nuclear energy.

Printed and published by Temple Press, Limited, Bowling Green Lane, London, E.C. 1, England, 12 post-paid issues cost $7 for Canada and the United States.

ASME Fellows *(continued from page 881)*

so-called lightweight streamlined train. He was a party to the conception of the principles, arrangements, structural design and many new features, and was responsible for directing the reduction of these ideas to practice. Mr. Murphy partook in and directed extensive work over 15 years on aluminum, low-alloy steels, their fabrication, and especially the design and production problems that had to be solved in the adoption of welding as a method of assembly of railroad cars. He personally outlined principles of design of a new a-c head-end power system. In 1945 he took the fundamental idea of a passenger dome in a car from General Motors, co-operated with them and developed the special car structure, the dome arrangements, car arrangements on several levels, designed and built for General Motors the first train of four-dome cars to run the rails. During the years 1945–1948 he sat in meetings as an advisor to, and at the request of, the Transit Research Corporation's Committee of Transit Operators who were engaged in the redesign of the PCC Streetcar. Mr. Murphy contributed fundamental engineering data in the development of a pressure-ventilating system for streetcars. From 1948–1951 he was Chairman of the Railroad Passenger Car Design Committee of the American Railway Car Institute. His publications include: "Progress in Railroad Mechanical Engineering," "Recent Trends in Railroad Freight Cars," "Characteristics of Passenger Cars From the Standpoint of Increasing the Comfort of Passengers and the Development and Use of Dome Cars," and "Trends in Railroad Passenger and Freight Car Designs." For ASME he served on the General and Executive Committees of the Railroad Division. He holds more than 20 patents pertaining to railroad cars and devices widely used in railroading.

Milton J. Thompson

MILTON JOHN THOMPSON, professor and chairman, aeronautical engineering department, The University of Texas, Austin, Texas, has made noteworthy contributions to the engineering profession. Professor Thompson served as associate director of the Defense Research Laboratory, University of Texas, since 1945. He directed the technical development of two supersonic wind tunnels, along with related research on boundary-layer work both in fluid mechanics and heat transfer. He has supervised two completed doctoral theses in this area and has under his supervision at least two others which should be nearing completion. As coauthor, with Prof. R. A. Dodge, of "Fluid Mechanics," he has contributed to the development and teaching of courses in fluid mechanics at a large number of engineering colleges. His work in aerodynamics has been of such a caliber that he has been named to several important technical defense committees and associated activities. He was cited as a Distinguished Alumnus of the College of Engineering at the University of Michigan in 1953. During 1945 Professor Thompson supervised the aerodynamics group of the "Bumblebee Project" in the Applied Physics Laboratory at The Johns Hopkins University. He has served as a consultant in numerous important aeronautical projects, some of which have been as follows: (1) Bureau of Ordnance "Bumblebee" Guided Missile Project, Aerodynamics Panel. (2) Bureau of Ordnance Aeroballistics Committee, Chairman, Panel on Drag, 1952–1956. (3) Research and Development Board, Guided Missiles Committee, Panel on Target Drones. (4) Consultant, Missile Systems Division, Lockheed Aircraft Corporation. Professor Thompson is the author of 18 technical papers some of which were published abroad. He has been a member of ASME since 1935.

Ford L. Wilkinson, Jr.

FORD LEE WILKINSON, JR., president of Rose Polytechnic Institute, Terre Haute, Ind., has been continuously active, since joining ASME in 1926, in responsible engineering assignments in both industry and education. From 1928–1930 he was chief engineer of the Bureau of Smoke Regulation, Knoxville, Tenn., which he organized and established in connection with work done by the late John Hunter, consulting engineer of St. Louis, Mo. For the following two years Mr. Wilkinson was development engineer with the Riley Stoker Corporation, Worcester, Mass. In 1933 he was appointed professor and head of the department of mechanical engineering at the University of Tennessee, Knoxville, Tenn., where he conducted preliminary steam studies for the TVA system. As dean of Speed Scientific School, 1938–1947, Mr. Wilkinson established and organized the Louisville Institute of Industrial Research and served as its president. During the period of 1943 to 1945 he served in the capacity of a vice-president of the ASME. Another important appointment held by Mr. Wilkinson was that of Academic Dean of the U. S. Naval Postgraduate School, 1947–1949. As president of the Rose Polytechnic Institute, which post he has held since 1949, major modifications and additions to school facilities have been made at the Institute. In 1951 Mr. Wilkinson was a member of the American Advisory Mission to Japan for engineering education. Currently he is a member of the Board of Public Affairs of the ASME.

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78 JENKINS PRACTICAL PIPING LAYOUTS

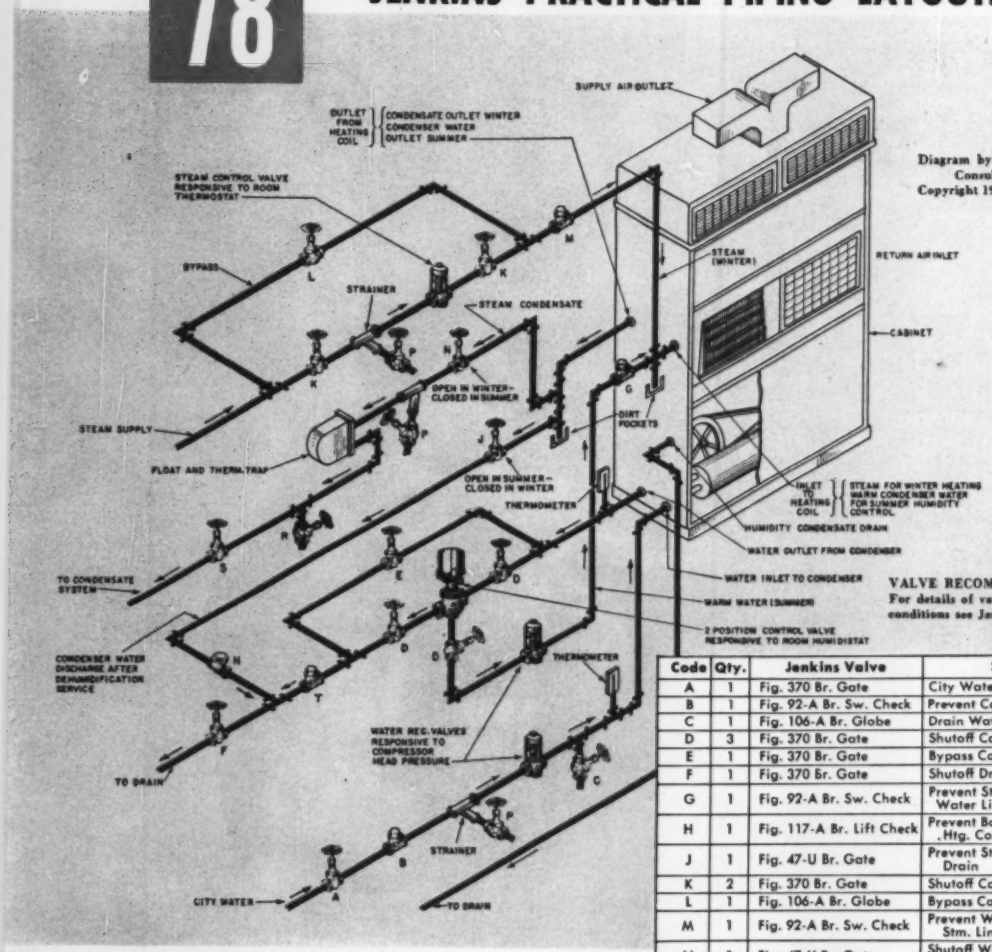

Diagram by Huxley Madeheim
Consulting Engineer
Copyright 1956 — Jenkins Bros.

VALVE RECOMMENDATIONS
For details of valves to suit varying conditions see Jenkins Catalog 56

Code	Qty.	Jenkins Valve	Service
A	1	Fig. 370 Br. Gate	City Water Shutoff
B	1	Fig. 92-A Br. Sw. Check	Prevent Contam. City Water
C	1	Fig. 106-A Br. Globe	Drain Water System
D	3	Fig. 370 Br. Gate	Shutoff Control Valve
E	1	Fig. 370 Br. Gate	Bypass Control Valve
F	1	Fig. 370 Br. Gate	Shutoff Drain Line
G	1	Fig. 92-A Br. Sw. Check	Prevent Stm. Flow To Water Line
H	1	Fig. 117-A Br. Lift Check	Prevent Backflow Thru Htg. Coil
J	1	Fig. 47-U Br. Gate	Prevent Stm. Flow To Drain
K	2	Fig. 370 Br. Gate	Shutoff Control Valve
L	1	Fig. 106-A Br. Globe	Bypass Control Valve
M	1	Fig. 92-A Br. Sw. Check	Prevent Water Flow To Stm. Line
N	1	Fig. 47-U Br. Gate	Shutoff Water To Cond. Syst.
P	4	Fig. 106-A Br. Globe	Strainer Blowoff
R	1	Fig. 106-A Br. Globe	Trap Test
S	1	Fig. 370 Br. Gate	Shutoff Condensate Flow

How to plan piping connections for an all-year

SELF-CONTAINED AIR CONDITIONING UNIT

A factory-built "package", the self-contained air conditioning unit shown in this layout is designed for both summer cooling and winter heating. In this particular system, it is assumed that steam is available for winter heating, and that the condenser is served by the city water supply. The condenser water discharge is used for the reheat necessary for humidity control.

The hookup for humidity control, particularly important for installations such as in night clubs, auditoriums, and others having a high moisture removal load, is shown in the diagram.

During the winter season, the heat output is regulated by a modulating steam valve which operates in response to a room thermostat. In the summer, another room thermostat starts the compressor when cooling is required, and the two-position water control valve, located as shown in the diagram, permits the water to flow to the drain.

When dehumidification is required without cooling, a room humidistat keeps the compressor in operation, but changes the position of the two-position water control valve so that the condenser discharge flows to the heating coil.

Two water-regulating valves are employed as illustrated. One, in the city water line, is set in the usual manner to maintain a predetermined head pressure on the compressor by varying the amount of water flowing into the condenser. The second, in the line from the condenser to the heating coil, is set for a head pressure higher than the pressure on the feed control valve.

This secondary condenser water control reduces cooling capacity and, at the same time, provides hotter water for reheat in the heating coil, thus serving to maintain proper relative humidity without excessive reduction of temperature. The amount of reheat obtained is approximately equal to the cooling provided by the unit, so that the net effect is that of dehumidification only, without cooling.

Consultation with accredited piping engineers and contractors is recommended when planning any piping system.

Enlarged diagram and full description of this layout free on request. Ask for Layout No. 78. Jenkins Bros., 100 Park Ave., New York 17.

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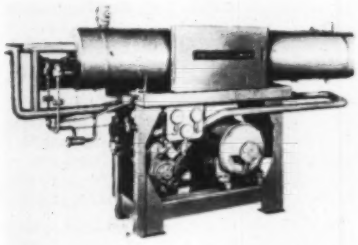
Available literature or information may be secured by writing direct to the manufacturer. Please mention MECHANICAL ENGINEERING

NEW EQUIPMENT



Packaged Water Chillers

A line of completely packaged and tested water chillers for air conditioning or industrial cooling applications is available from American Blower Corp., Detroit 32, Mich.

Designated as Type CC, the chillers are available in capacities from 20 through 150 tons. Each packaged chiller unit consists of base and framework, reciprocating type Freon-22 compressor, direct-expansion chiller section, heat exchangers, control panel, electric drive motor and associated valves, strainers and gages. Across-the-line magnetic motor starters are standard equipment.

A major component in the chillers is a new copper tubing with a star-shaped aluminum insert. This new tubing is said to have more than double the heat-transfer surface of plain tubing and add 25 per cent more cooling capacity per cubic foot of chiller size.

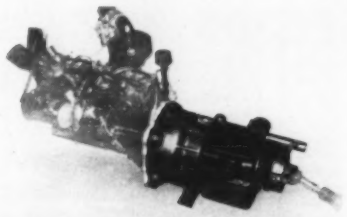
The chiller element has a shell of seamless steel tubing. Tubes are of $^{3}/_{4}$-in. OD seamless copper and are roller-expanded into the tube sheets in such a manner as to assure leakproof tube joints. Water connections 3 in. and smaller are extra heavy pipe couplings. Connections larger than 3 in. terminate in 150-lb ASA steel flanges with a threaded cast-iron companion flange.

Design working pressure for the tube side is 235 psig; for the shell side, 150 psig. Test pressures are 300 psig for the tube side, 300 psig for the shell side. Tubes, shell, heads and tube sheets are fabricated of materials which meet ASME specifications. Refrigerant head gaskets are die-cut out of medium-density neoprene. Water baffles are fabricated of zinc-plated hot-rolled steel. Brass baffles for special applications are available as an option.

Safety Head Disc

Black, Sivalls & Bryson, Inc., 7500 E. 12th St., Kansas City 26, Mo., announces a new type rupture disc designed to extend the advantage of safety head protection to many installations now operating under pressure, temperature and corrosive conditions too severe for conventional type discs.

The rupture disc is the heart of the safety head assembly, made from a variety of thin ductile metals selected on the basis of operating requirements. The firm says the new D and DV rupture disc extends the range for high temperature applications, provides maximum service under pulsating or reversing pressure conditions, and permits closer operation to rupture pressure. The disc is also said to make lower minimum rupture pressures possible and give extended service under pressure surges that approximate the rupture pressure. Complete information on the disc is included in catalog 77-31.

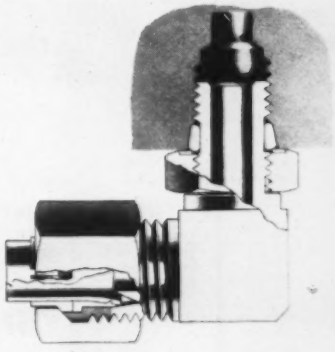


Planetary Transmission

Six new models of its Plan-Gear transmission have been announced by the American Gear & Mfg. Co., Lemont, Ill., a subsidiary of Brad Foote Gear Wks., Inc., Cicero, Ill. The units have been particularly designed for use on road building machinery, lift trucks, and similar equipment.

Introduction of the models provides a complete line of seven different Plan-Gear transmissions, the firm states. Of the compound planetary type, these transmissions range from 85 or 150 lb-ft to 200 lb-ft torque output. They are provided with one or two forward speeds and a variety of reverse gear ratios. Bell housings provided with some of the models enable them to be used with Borg & Beck Torque converters, and Chrysler torque converters and Chrysler engines.

By moving a single hydraulic control lever, the operator obtains 1.5-second change of speed or direction without shifting gears. The clutch pedal has been eliminated.



O-Ring Fitting

A new, straight-thread O-ring locknut fitting, available in all styles and in sizes from $^{1}/_{8}$ to 2 in., is announced by Flodar Corp., 16911 St. Clair Ave., Cleveland 10, Ohio.

The new fitting is claimed to be leakproof, provide safer high pressure connections and be exceptionally easy to position. In addition, the new hydraulic fitting is interchangeable and meets all SAE and JIC standards.

The fitting is available in the firm's self-flaring, no-flare and flare type fittings. Detailed information may be obtained by writing the manufacturer for descriptive catalogs.

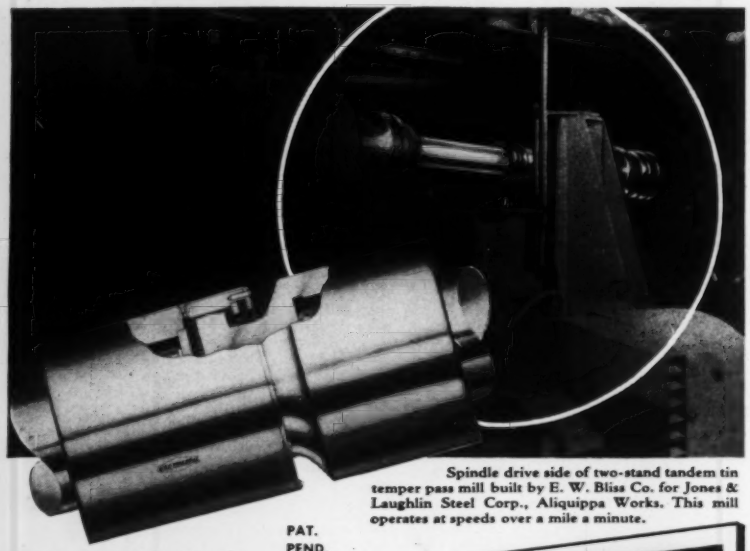
Gas Regulator

A regulator which will withstand momentary overloads as high as 1000 psi on the outlet side has been introduced by Rockwell Mfg. Co., 400 N. Lexington Ave., Pittsburgh 8, Pa.

Designed primarily to provide extra safety for rural gas services, particularly where the gas is piped directly to rural homes from high-pressure pipelines, the new "141" regulator offers the highest capacity in its size range, the firm states.

With a maximum recommended outlet pressure of 400 psi, the unit operates with a wide margin of safety. It has four interchangeable orifices and five interchangeable springs to enable the regulator to operate on pressures ranging from 3 psi to 400 psi.

Changes from one to another of four separate settings in the 3-to-100-psi range are made by replacing the spring. For the fifth setting—200 to 400 psi—a reducer plate must be used with the spring. The same sturdy diaphragm assembly is used for both low and high pressures.



Spindle drive side of two-stand tandem tin temper pass mill built by E. W. Bliss Co. for Jones & Laughlin Steel Corp., Aliquippa Works. This mill operates at speeds over a mile a minute.

PAT. PEND.

Cut-away view of Ajax Dihedral Coupling showing arrangement of teeth.

This 37" x 80" 2-high temper pass mill is cutting tonnage costs in the Fairless Works of the U. S. Steel Corp. at Morrisville, Pa.

Ajax Floating Shaft Dihedral Couplings solve angular drive problems on tilting tables for the Green River Steel Corp., at Owensboro, Kentucky.

Two Ajax Dihedral Floating Shaft Couplings driving SECO 48" heavy duty slitter in operation at McLouth Steel Co., Detroit, Michigan, cutting ¼" stainless steel at 100 ft. per min. with 16" diameter knives.

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Designers and users of modern mills are achieving new high speeds (up to 7200 feet per minute), new high uniformity of gauge, new high quality finish and new high production and maintenance economies. Ajax patented dihedral tooth design is revolutionizing spindle shaft drives. Ajax Dihedral Spindle Shaft Couplings are the talk of hard-boiled steel men everywhere. Write for the facts.

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Chemical Feed Pump

Chemical feed pump-model 4411 has been announced by Hills-McCanna Co., 2433 W. Nelson St., Chicago 18, Ill. The model has a maximum capacity of 7 gph/feed and discharge pressures up to 600 psi.

The unit was specifically designed for applications requiring a delivery rate of 7 gph/feed or less. Of the positive displacement, plunger type pump, the model contains many built in operational features such as "capsulated" construction, that are used in larger capacity chemical feed pumps. This pump is said to be suited for applications requiring precision and economy in the continuous feeding of chemicals used in water conditioning, chemical process additive feeding, petroleum inhibitor addition and other similar applications.

Tracing Table

A modern, extra-thin tracing table designed specifically for use by engineers, photographers, X-ray technicians, designers and artists is manufactured by Porta-Trace, Inc., Dept. ME, 342 Clinton St., Binghamton, N. Y.

It is said to be lightweight, portable and easy to store yet strong enough to permit tracing on Bristol board. The unit is $1^{7}/_{16}$ in. thick. Because of its low height and flush top, drawings which are actually larger than the unit, can be traced, the company states. The unit is thin enough to be used under a string straight edge.

A Plexiglas top is designed to provide light diffusion with minimum glare.

The unit is made in four sizes: from 11 × 18 in. to 24 × 36 in. List prices start at $32.50.

Teflon Film Tape

A Teflon film tape, designed especially for application where Class H electrical insulation and resistance to abrasion are required, has been developed by the Permacel Tape Corp., New Brunswick, N. J.

The new tape, designated No. 421, can be used as a dielectric for condensers where its nearly zero moisture absorption and high dielectric are needed, and as an insulation medium for FM and TV transmission lines, where low power factor and high operating temperature are important. Industrially, the tape can be used as a barrier or protective coating against highly reactive chemicals and solutions, the company states.

Average characteristics of the tape include tensile strength 30 oz per in. of width; elongation 250 per cent; adhesion to steel 25 oz per in. of width; and caliper of 6.8 mils.

The tape has average insulation resistance at 96 per cent relative humidity of 400,000 Megohms; indirect corrosion current of 2.50 Micromicromohos; is nonflammable and has permissible continuous operating temperatures ranging from −500 F to + 500 F. The tape is available in widths ranging from $^{1}/_{4}$ to 6 in. and in rolls of 36 ft.

KEEP INFORMED

NEW EQUIPMENT
BUSINESS NOTES
LATEST CATALOGS

Cocentric Scale Dials

A line of direct reading cocentric scale dials has been introduced by Borg Equipment Div., the George W. Borg Corp., Janesville, Wis.

The new models feature a finger tip brake which prevents accidental change of setting. The dial is $1^{3}/_{4}$ in. in diam, and is available in eight dial and cover combinations of bright chrome, satin chrome, gloss black and dull black. Black bakelite knobs are used on all models. They are available with or without finger tip brake.

The turn-counting dial reads up to 10 turns and clearly distinguishes between the tenth turn and the zero point, the firm says. The increment dial has 100 equal divisions and is attached directly to the actuating shaft eliminating backlash.

Larger Belt Hook

A larger belt hook for use with belts $^{3}/_{8}$ in. thick, but not over $^{13}/_{32}$ in. thick, is now available from the Clipper Belt Lacer Co., Grand Rapids 2, Mich. Designated No. 7, the hook features a double-staggered grip to provide even distribution of hook-point pull on the belt.

Field tests on the hook show it provides longer service on heavy-duty two-ply leather belts and on six- or seven-ply rubber-composition belts. Use of longer hook points on the unit has provided better clinch of points. Tests have also shown the hook easily withstands pulls up to 125 lb per hook, the firm states.

Hooks are carded using 0.1445-in. centers. The standard box contains twelve 12-in. cards complete with sufficient pins for joining.

Level Control

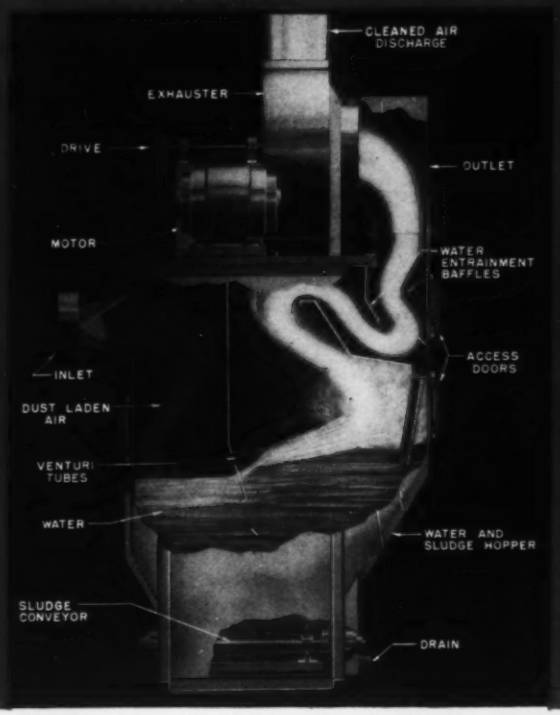
Photoswitch Div., Electronics Corp. of America, 77 Broadway, Cambridge 42, Mass., announces a new electromagnetic level control—Type 10CB4—for the control of all electrically conductive liquids in the chemical, waterworks, food processing, dairy, and sewage fields.

The unit, used with the firm's probe type fittings, is said to provide maintenance-free operation with complete flexibility of application. There are no moving parts in the tank and no floats or stuffing boxes. In a single control, four different ranges of resistivity of the probe circuit are provided to match the conductivity of the liquid being controlled. The unit can be used for single level indication or alarm, or pump-up or pump-down control.

The control operates on 115/230 v 25/60 cycles ac. Extremely low voltage is employed in the probe circuit to assure safety and eliminate the problem of electrolysis. The control relay is rated at 10 amp at 115 v, 5 amp at 230 v, and is designed for motor starter, or motorized or solenoid valve operation.

Bulletin PF 544a, describing the new control is available from the company.

NEW PANGBORN VENTRIJET
Gives Efficient Wet Dust Control



Efficient wet dust collection depends on breaking water into particles and mixing it with the dust. The new Pangborn VENTRIJET Collector utilizes venturi tubes to achieve this effect. As dust-laden air enters the inlet chamber, heavier dust particles sink to the bottom. The air stream then passes through the venturi tubes at high velocity, drawing water with it and breaking it into minute particles. These particles mix thoroughly with the remaining dust in the air and give the VENTRIJET its high operating efficiency. In the outlet chamber, the resulting sludge settles to the bottom for removal. Eliminator sections remove water droplets in the washed air and the cleaned air is then discharged. The result is peak performance in a minimum of space.

Pangborn VENTRIJET offers these advantages:

- **Complete, self-contained unit with low headroom, minimum floor space**
- **High air velocity through venturi tubes insures thorough mixing of air and water**
- **Venturi tube design results in minimum pressure loss and provides uniform flow—no narrow channels to become choked with sludge**
- **Tube design and thorough washing action enable collector to handle heavy loads.**

For full details, write to PANGBORN CORPORATION, 2200 Pangborn Blvd., Hagerstown, Maryland.

3D

Pangborn CONTROLS DUST

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Silicone Rubber Compounds

Three advanced silicone rubber compounds particularly suitable for producing O-rings complying fully to AN, MS, SAE, JIC and NAS dimensions and tolerances are announced by Goshen Rubber Co., Inc., Goshen, Ind.

The compounds, supplied in durometer hardness of 60, 70, and 80 and useful over a −80 F to +500 F temperature range, are said to be unique in that molding shrinkage duplicates that of organic rubbers, effecting savings through elimination of previously required special tooling, tool construction-time delays, and high rejection rates.

The firm says that advantages include maintenance of consistent, in-tolerance dimensions, and use of available greater-capacity standard tooling with resulting lower unit cost. These compounds are non-toxic, and have zero moisture absorption, even completely submerged in boiling water.

Adjustable Diameter Bearing

A new type ball bearing for linear motion has been developed and is now in production by Thomson Industries, Inc., Manhasset, N. Y. The bearings, known as adjustable diameter ball bushings, are split longitudinally as illustrated and are designed to provide line-to-line or slight preload fits when mounted in an adjustable diameter housing.

The firm says the bearings enable the tolerance on both the shaft diameter and bearing bore to be adjusted out. In addition, the principle provides for compensation for wear.

The bearings are frequently used in a housing that it merely split and provided with an adjusting screw. Drawings are available from the manufacturer showing numerous other arrangements which are being used in the design of machine tools, special machinery, small precision mechanisms and many other devices where free linear motion is desired and shake or play is detrimental.

Adjustable diameter ball bushings are available in standard sizes for shaft diameters ranging from 1 to 4 in. Literature containing dimensions, load ratings, and other technical data is available from the manufacturer.

Continued on Page 46

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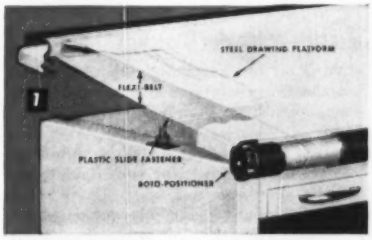
Now . . . instead of standing, stooping, stretching, perching on the edge of a stool . . . the draftsman can remain comfortably seated in an adjustable office chair while Draft-a-Matic's exclusive Roto-Positioner brings all parts of his drawing within easy working range. This increases efficiency by reducing fatigue, improves morale by providing greater working comfort.

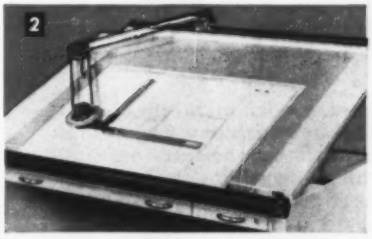
Increased productivity is just one of the reasons why engineering costs go down when you install Draft-a-Matic.

Find out for yourself the many reasons why Draft-a-Matic has made conventional drafting desks obsolete, and specifically what it can do for you. See it now at your local GF showroom – look in the Yellow Pages – or write for free 8-page Draft-a-Matic booklet. The General Fireproofing Company, Dept. Q-58, Youngstown 1, Ohio.

THESE FEATURES MAKE **DRAFT-A-MATIC** *WORLD'S FINEST*

- All metal construction with baked-on finish. No warping.
- Velvoleum covered drafting platform adjustable 0 to 85°.
- Height of entire unit adjustable from 31" to 39" at 1" intervals.
- Large center drawer with locking instrument tray.
- Shelf and storage drawer arrangements to suit individual needs.
- Large sliding reference shelf for extra convenience.
- Designed for space-saving row installation.
- Accommodates parallel straight edge, drafting machine, lamp.
- Exclusive Flexi-Belt and Roto-Positioner delivers the work to the man.





1. Drawing is affixed to endless vinyl plastic belt. By merely turning Roto-Positioner wheel, draftsman moves drawing into working range while remaining comfortably seated.

2. Draft-a-Matic will accommodate drafting machine, parallel straight edge, lamps and similar accessories. Drawing platform is covered with Mist Green Velvoleum.

3. Row arrangement creates a complete work station in only 32 square feet. Immediately behind draftsmen are drawers and shelves for reference material and a handy sliding work shelf.

MODE-MAKER DESKS • GOODFORM ALUMINUM CHAIRS
SUPER-FILER MECHANIZED FILING EQUIPMENT • GF ADJUSTABLE STEEL SHELVING

GF metal business furniture is a **GOOD** investment

GF
GENERAL FIREPROOFING
Foremost in Metal Business Furniture

Dust and Fume Collection by Norblo

helps you achieve efficiency and cleanliness in your plant

Norblo has developed bag type dust collection systems to a high degree of efficiency.

Norblo Automatic Bag Type

For continuous and heavy duty service at constant capacity and efficiency, Norblo Automatic Bag Type collection pays its own way — in recovery of valuable materials or removal of injurious or "nuisance" industrial air contaminants. Norblo builds the entire installation, from blowers to bag-cleaning mechanisms. Complete systems are engineered to meet specific situations. Norblo engineering insures low maintenance and no shut-downs — guarantees performance of every installation.

Norblo Standard Bag Type Collectors

Based on the same construction principles, the standard bag type collectors provide at low cost the high efficiency service that is obtainable only from bag-type cloth filtering, with either compressed air or electrically driven periodical bag shaking and cleaning. Units must be shut down for cleaning — at such times as the noon hour and end of working day.

Norblo Portable Type

For excellent results in localized dust control, Norblo Portables protect equipment and reduce maintenance in grinding, polishing and cutting departments. Six models cover capacities from 300 to 1350 cfm., at 8" static pressure at the fan. Occupy small space. Are unusually quiet.

Write for bulletins describing Norblo bag type dust collectors.

The Northern Blower Company

6421 Barberton Ave., Cleveland 2, Ohio • OLympic 1-1300

Norblo ENGINEERED DUST COLLECTION SYSTEMS FOR ALL INDUSTRIES

KEEP INFORMED — NEW EQUIPMENT, BUSINESS NOTES, LATEST CATALOGS

Welding Flux

A new dry type welding flux for use when applying nickel and cobalt base hard-facing alloys to hard-to-weld metals is now available from Wall Colmonoy Corp., 19345 John R St., Detroit 3, Mich.

Called Flux 6–20, the new material is said to impart excellent flow characteristics to hard-facing alloys. Designed to include a unique eye-saving formula, it contains no glare-producing salts. The new flux was developed for use in hard-facing iron and nickel base alloys containing chromium, titanium and/or aluminum. It is also claimed to be excellent for use on cast iron parts.

The firm says metals readily hard-faced where 6–20 Flux is used are Inconel X, M and 700; Nimonic 75, 80, 80A and 90; Duranickel and Duranickel R; K-42-B; K and KR Monel; Permanickel; any 200, 300 or 400 series stainless steel; 17–4 PH, 17–7 PH, A286, 16–25–6, 19–9DL, 19–9DX, and other variations. The flux is available packaged in 1-lb metal containers.

Granite Surface Plates

A line of uniquely lapped black granite surface plates is now being marketed by Collins Microflat Co., 2326 E. 8th St., Los Angeles 21, Calif. Seizure of gage blocks and checking fixtures, which has occasionally occurred when using granite surface plates, has now been eliminated by a unique lapping method which provides a continuous bearing surface interspersed with micronic valleys, the firm states.

These minute reliefs, formed by an exclusive lapping procedure, are said to afford sufficient air pocket relief between bearing surfaces to prevent seizure of instruments. The subdivisions of the grain pattern are so small as to be invisible to the naked eye.

The plates are available in either two ledge or four ledge styles and are finished down to 50 millionths overall accuracy.

Electro-magnetic Clutches

A line of miniature electro-magnetic clutches is available for electronic and instrument applications from A. J. Thompson, Inc., Route 1, Box 812, Florissant, Mo. The new line couples the input hub to the output shaft when energized, and both the hub and output shaft are free when de-energized, according to the company's announcement.

The servo mounted units are available with output shaft at either or both ends. Controlled torque output under vibration meets requirements of MIL-E-5272A. Units operate on d-c voltage.

Performance specifications of the C-4 Model are 0.59 in. in diam by 0.93 in. long (excluding input and output shafts), weighing 8 oz and transmits 4 in. oz of torque. The C-6 Model is .83 in. in diam by 1.34 in. long (excluding shafts) weighing 2.3 oz and transmits 16 in. oz of torque. The C-10 Model is 1.37 in. in diameter by 1.765 in. long and transmits 60 in. oz of torque.

KEEP INFORMED

NEW EQUIPMENT
BUSINESS NOTES
LATEST CATALOGS

Die Handling Truck

A truck designed for handling dies onto medium to large size inclined presses has been developed by The Elwell-Parker Electric Co., 4205 St. Clair Ave., Cleveland 3, Ohio.

The firm says the new die handling truck, with a capacity of 5000 lb, permits changing dies more rapidly, thus reducing press downtime. Also, possible damage to the die or the press is almost entirely eliminated, as is the danger of injury to personnel.

The special die handler is built on the chassis of an electric powered high lift platform truck which is equipped with a rotating, tilting platform 44 in. long and 50 in. wide. By tilting the rear of the platform upward to match the angle of the press bed, dies can be pulled onto the platform over the end of the truck.

If operating space or the shape of the die require side loading, the truck can be positioned alongside the press and the platform rotated either to the right or left to match the angle of the press bed. Both the tilt and the rotate functions are actuated by double acting hydraulic cylinders. The platform can be raised or lowered by means of an hydraulic lift cylinder to permit proper height alignment.

In addition to operations on inclined presses, the truck can also be used for die handling in and out of standard horizontal presses, the company says.

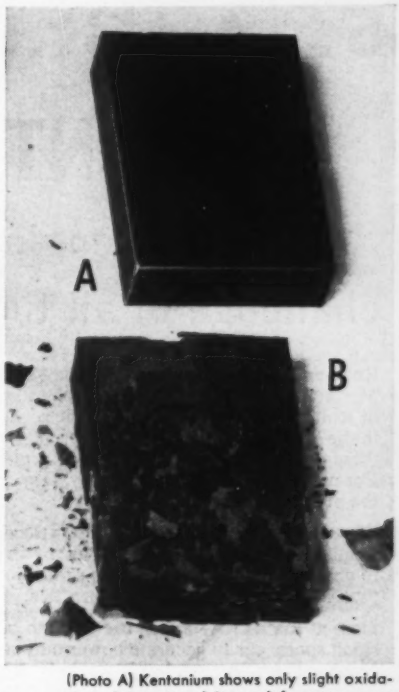
Plastic Axial Fans

Axial fans of solid plastic construction have been added to the line of corrosion resistant ventilation equipment manufactured by Heil Process Equipment Corp., 12901 Elmwood Ave., Cleveland 11, Ohio. The units complement solid plastic centrifugal blowers and the axial and centrifugal lined and coated steel units now available from the firm.

Constructed of either rigid vinyl or glass-reinforced plastic these fans are designed for corrosive services. The vinyl fans are designed for use with strong acid or alkali fumes at temperatures up to 150 F. The glass-reinforced plastic fans are recommended for most acid fume services and higher temperatures in the 200 F range. Hydrochloric, sulphuric, nitric, phosphoric, hydrofluoric and other acid or mixed fumes can be handled. The firm says problems of maintenance due to chipped or worn coatings are eliminated, and longer service life is assured because of complete internal and external resistance afforded by the solid plastic construction.

Standard sizes of 18, 24, 30, and 36 in. and larger are available, with capacities from 2000 cfm and upward. All units are V-belt driven and designed with corrosion resistant seal, slinger ring, external grease fittings and externally vented bearing housing so that the drive is completely isolated from corrosive fumes. The fans are dynamically balanced to assure quiet, vibration-free-service.

KENTANIUM*
unharmed
at 2000°F
while
heat-resistant
nickel-chrome
alloy
disintegrates



(Photo A) Kentanium shows only slight oxidation after test and is good for many more hours' exposure at 2000°F. (Photo B) Hard nickel-chromium (35%) alloy is badly oxidized and began to disintegrate during test.

Exceptional resistance to oxidation, combined with great strength at very high temperatures, are characteristics of Kentanium, a titanium carbide composition. Here's proof.

A square of K161B Kentanium and a similar square of a well-known, heat-resistant 35 chromium-15 nickel alloy were exposed for 120 hours in an unsealed muffle furnace heated to 2000°F. The accompanying photographs vividly show how each piece was affected. While Kentanium is still good for hours of exposure at high temperatures, the nickel-chrome alloy has oxidized badly and has begun to disintegrate.

This demonstration suggests how well Kentanium will perform in such applications as furnace parts, heat-treating fixtures, quench guide rings, turbine blades, nozzle vanes, bushings and other parts where strength at high temperature, plus high resistance to oxidation, are factors.

Parts illustrated at the right are typical applications of Kentanium. The Kentanium series represents only a part of Kennametal's wide range of hard carbide compositions that are helping designers who require metals offering high resistance to abrasion, deflection, deformation, impact or corrosion. Perhaps one or more of these Kennametal compositions will help you get your idea off the drawing board into production. These materials are described and many applications discussed in two booklets: B-111-A—"Characteristics of Kennametal," and B-222—"Designing with Kennametal."

Write KENNAMETAL INC., Latrobe, Pa.

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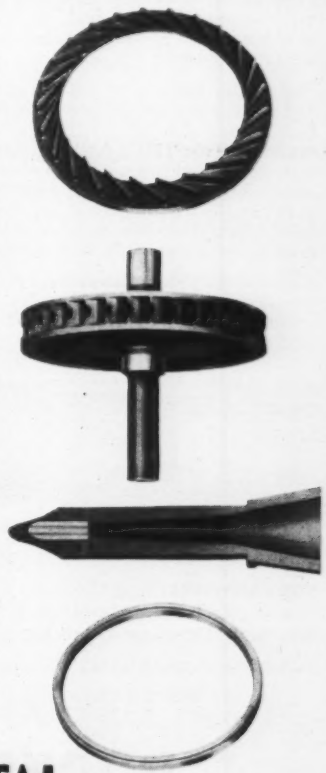
8-5976



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5...4...3...2...1...?

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on the BIG engineering challenge of all time!

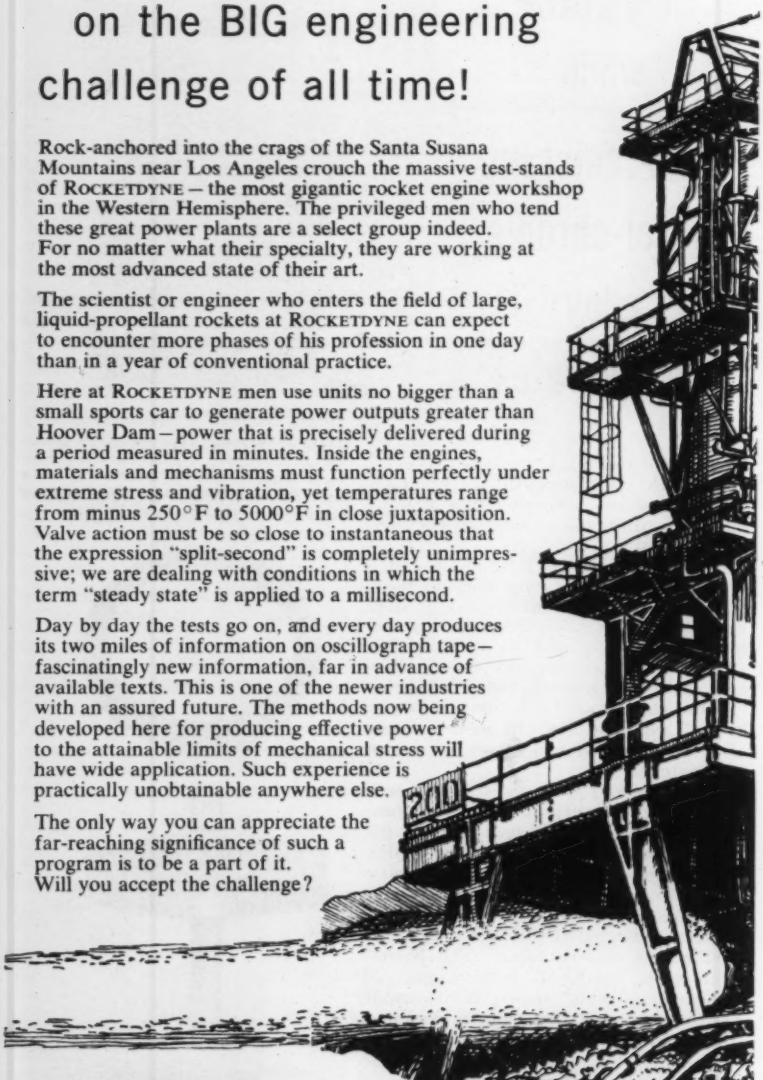
Rock-anchored into the crags of the Santa Susana Mountains near Los Angeles crouch the massive test-stands of ROCKETDYNE – the most gigantic rocket engine workshop in the Western Hemisphere. The privileged men who tend these great power plants are a select group indeed. For no matter what their specialty, they are working at the most advanced state of their art.

The scientist or engineer who enters the field of large, liquid-propellant rockets at ROCKETDYNE can expect to encounter more phases of his profession in one day than in a year of conventional practice.

Here at ROCKETDYNE men use units no bigger than a small sports car to generate power outputs greater than Hoover Dam – power that is precisely delivered during a period measured in minutes. Inside the engines, materials and mechanisms must function perfectly under extreme stress and vibration, yet temperatures range from minus 250°F to 5000°F in close juxtaposition. Valve action must be so close to instantaneous that the expression "split-second" is completely unimpressive; we are dealing with conditions in which the term "steady state" is applied to a millisecond.

Day by day the tests go on, and every day produces its two miles of information on oscillograph tape – fascinatingly new information, far in advance of available texts. This is one of the newer industries with an assured future. The methods now being developed here for producing effective power to the attainable limits of mechanical stress will have wide application. Such experience is practically unobtainable anywhere else.

The only way you can appreciate the far-reaching significance of such a program is to be a part of it. Will you accept the challenge?



Here are the fields of opportunity at ROCKETDYNE:

FOR ENGINEERING GRADUATES: Aeronautical, Chemical, Structural, Electrical, Electronic, Metallurgical, Mechanical; qualified for Analytical, Research, Development or Design responsibility.

FOR SCIENCE GRADUATES: Physics, Chemistry, Mathematics.

INTERESTING BOOKLET. Facts about rocket engines and engineering. Send for your personal copy of "The Big Challenge." Write: A. W. Jamieson, Rocketdyne Engineering Personnel Dept. 9 ME, 6633 Canoga Avenue, Canoga Park, Calif.

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BUILDERS OF POWER FOR OUTER SPACE

KEEP INFORMED — NEW EQUIPMENT, BUSINESS NOTES, LATEST CATALOGS

Automatic Centering Machine

A machine designed to perform a centering operation on such parts as motor cam shafts and crank shafts at a high production rate has been announced by the Govro-Nelson Co., 1933 Antoinette, Detroit 8, Michigan.

The machine, which incorporates two opposed automatic drilling units, is said to be simple to operate. The operator loads the part into a fixture and depresses the start cycle switch, whereupon the work is automatically clamped, centered at both ends and unclamped, ready for the operator to remove. The production rate is approximately 360 pieces per hour.

By making minor changes, the machine can be readily adapted to a variety of parts, the firm states.

Torque Tester

Torque wrench calibration is said to have been simplified and made more accurate with a new type tester built by Baldwin-Lima-Hamilton Corp., 806 Massachusetts Ave., Cambridge 39, Mass. In this tester torque is measured electrically by means of special SR-4 resistance wire strain gage type torque transducers.

The first tester was recently designed and built for checking torque wrenches used on aircraft. Other devices can be calibrated with minor modification of the tester, the firm states.

The tester is portable, maintains its accuracy through a wide temperature range, is easy to use, and covers a wider range of torque testing capacity than available heretofore in one unit, according to the company. There are no moving parts, knife edges, mechanical linkages, or friction devices on the unit. Torque is sensed by small interchangeable torque pick-ups on which SR-4 strain gages are bonded.

The torque measuring system consists of an electronic amplifier and an indicating instrument with rotating dial on which torque can be read in inch-pounds: 1 in-lb per division up to 2040 in-lb and 5 in-lb per division up to 6200 in-lb. The low range is provided in five steps of 440 divisions each and the high range in three steps of 440 divisions each. Separate torque pick-ups are used for the two ranges.

Loads are applied on the handles of torque wrenches hydraulically through an adjustable fulcrum and the tester is powered by plugging into a 115-volt, 60-cycle electric line. Pick-up cells are provided with hex, square, and special adapters in sizes that will meet all requirements. Storage space is provided in the tester cabinet for accessories.

Operating controls include a loading knob, range selector switch, and load step switch to utilize the 440-division indicator scale on different sections of the full scales to 2040 and 6200 in-lb. The tester itself can be calibrated readily by means of a calibration arm and dead weights.

The tester is 40 in. long, 24 in. deep and 18 in. high overall. Total weight is 300 lb.

KEEP INFORMED

NEW EQUIPMENT
BUSINESS NOTES
LATEST CATALOGS

Shell-Ice Maker

Shell-ice, small, curved pieces of ice widely used in dairies, fruit and vegetable packing, restaurants, hospitals, is frozen at high speed by water flowing down the outside of cold stainless steel pipes that look like organ pipes and is manufactured by Frick Co., Waynesboro, Pa.

The cycle is completely automatic and can be adjusted to deliver ice from $\frac{1}{8}$ to $\frac{1}{2}$ in. thickness as desired. When ice has been built up to the proper thickness on the tubes, the refrigerant is cut off and warm gases are passed through the tubes. The "sleeves" of ice slip off and are broken into small curved flakes by rotating blades under the tubes.

To make sure the freezing cycle is not started before the ice has come off all the tubes, the firm's engineers devised sensitive "fingers" molded of Ace-Ite to "feel" each tube and determine when it is free of ice. Ace-Ite is a special high styrene rubber plastic co-polymer, blended and molded by American Hard Rubber Co., 93 Worth St., New York 13, N. Y.

Interval Timers

A new series of automatic resetting interval timers for commercial, industrial, process control and laboratory use has been announced by Cramer Controls Corp., Centerbrook, Conn.

Available in full-scale ranges from 15 seconds to 24 hours, the new Type 241 interval timers feature a completely new drive and automatic reset mechanism actuated by a precision-built, high-torque, permanent-magnet-type synchronous motor. The motor develops a minimum torque of 30 in.-oz at 1 rpm.

A fully enclosed 300-deg black-on-white dial, a black setting pointer, and a red progress pointer are designed to permit easy reading at a distance and facilitate setting. A red start button and large concentric setting-control knob are included.

Repeat accuracy within ±0.25 per cent of full scale throughout service life is claimed to be achieved by the new timer. A nylon pinion is used in the gear train. Large, open-blade, silver-cadmium-oxide contacts, rated at 15 amp non-inductive load, are said to provide capacity to handle high inrush currents. Bulletin PB-211, describing the timers, is available from the company.

This is an actual photo of a surface prepared by polishing and etching a cross-section of a forging, to reveal the "grain flow." (x2)

A PICTURE OF ADVANTAGES YOU CAN GET ONLY FROM FORGINGS

In the picture above you see the grain flow in a forging.

This picture demonstrates two things. First, the metal is dense and free from porosity. The impact or pressure of forging helps make it so. Such density is important when parts must have machined surfaces, when they must provide reliable strength and safety, and when they must be tight against leakage of liquids or gases. This quality reduces rejects and saves money. It contributes to safety and saves lives.

Second, notice how grain flow lines follow the shape of the part. This improves impact resistance and fatigue strength of the part. In closed-die forging, these flow lines can be positioned, to give maximum properties where they are needed. As a result, forged parts can be lighter, safer, stronger, and frequently less costly.

Thus this picture shows you why forged metal is *metal you can trust*. You can trust forgings for performance, and to save money. Find out how forgings can improve your products, your costs. Consult a *Forging Engineer*, and send for the booklets offered below.

closed-die **forgings** for metal you can trust

DROP FORGING ASSOCIATION DPT. ME
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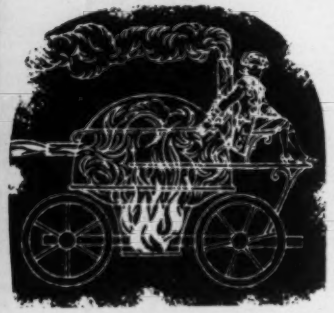
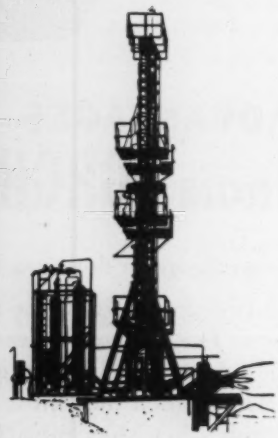
Symbolic emblem of the Drop Forging Association

Attach this advertisement signature to your letterhead and mail to Drop Forging Association to receive booklet "What is a Forging?" ☐ or "Management Guide to Use of Forgings". ☐ Check title or titles desired

MECHANICAL ENGINEERS



Stimulation, status, security . . . the absorbing challenge of the rocket propulsion field, the rewards of professional recognition, the stability of a firmly established organization . . . are yours at Aerojet-General.



Aerojet offers experienced mechanical engineers and recent graduates unparalleled carreer opportunities on a variety of important problems.

Design and development of pumps, valves, control and propellant systems for huge new liquid-propellant rocket engines.

Design and testing of a variety of thrust chambers, turbines, injection systems, and servomechanisms.

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Design and development of thrust reversers for jet engines.

Design and testing of underwater jet engines and other devices.

Design of test equipment and production machinery.

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Write: Director of Scientific and Engineering Personnel, Box 296BB, Azusa, Calif. or Box 1947BB, Sacramento, Calif.

KEEP INFORMED

NEW EQUIPMENT | BUSINESS NOTES | LATEST CATALOGS

Centrifugal Pump

Centrifugal pumps constructed of 316 stainless steel have been added and are available from stock, it is announced by Ampco Metal, Inc., 1745 S. 38th St., Milwaukee 46, Wis.

All parts of the new pumps in contact with the solution pumped are stainless steel. Shafts and fasteners are also of stainless steel. Supporting pedestals, protective shaft sleeves and impellers may, if desired, be selected from other wear and corrosion-resistanr alloys.

The single-stage, single-suction pumps are stocked completely assembled with maximum diameter impellers and are available for immediate shipment with or without base and coupling for NEMA frame motors. However, various deviations from the standard off-the-shelf pumps plus a choice of several accessories can also be supplied.

These include: special lubricating systems; hook type shaft sleeves; extra rigid shafts; high capacity double-row bearings; packed stuffing box with several kinds of ceramic and carbon, stellite and carbon, and other combinations. Complete parts inventories will be maintained for both the standard stainless pumps and special accessories for immediate shipment of all repair and replacement parts.

They are available in sizes from $1^1/_2 \times 1^1/_4$ in. to 4 × 3 in. with capacities to 600 gpm and heads to 160 ft.

Water Meter Recorder

F. S. Brainard Co., Hartford, Conn. has announced the introduction of a new, improved model of the Meter-Master, standard rate recorder for water meters. The company says the instrument, has been completely redesigned under a new patent application to incorporate many features that improve performance, accuracy and ease of handling.

The unit records on a chart the rate and time of flow over a selected period. The new model can be attached to any meter—single or compound—in three minutes, and automatically charts the rate and time of flow over a designated period to present a permanent record of the use of water for that particular service.

While recording the flow, the unit does not interrupt the operation of the meter nor obstruct the dial. It operates mechanically without the need for electric power.

Greater simplicity is said to have been effected in the new model by elimination of one of the flexible shafts. The instrument can now be attached directly to the meter. The unit can be furnished to record five chart speeds—as selected—two hours, six hours, twenty-four hours, seventy-two hours and seven days.

The instrument is assembled of aluminum and brass throughout and weighs seven lb compared to 17 lb of the previous models. It comes equipped with a lock and complete kit for attaching to any meter.

Mill Bearings

Link-Belt Co., Dept. PR. Prudential Plaza, Chicago 1, Ill., has expanded its line of mill bearings to include bearings for shafts up to 11-in. diam.

Mill bearings, with heavy duty, self-aligning roller bearings and steel housings, are especially designed for the operating conditions found in steel mills, mines, foundries, oil fields, and similar operations where severe radial and thrust loads must be expected.

The self-aligning feature in mill bearings assures full load carrying capacity, even when the bearing is subjected to shaft deflections caused by heavy shock loads or support inaccuracies, the firm states.

The bearings are available for shaft diameters ranging from $2^7/_{16}$ to 11 in. They can be furnished with one of three seal arrangements: steel labyrinth seals for use with oil or grease; combination felt and synthetic rubber contact-type seals for use with grease only; and double seals on bearing sizes $7^1/_2$ in. bore and larger.

Welded Steel Tubing

Revere Copper and Brass Inc., Rome, N. Y. has announced that welded steel tubing may now be purchased in sizes up to 5 in., OD and in wall thicknesses from .065 to .250 in.

The company said this addition to the line followed the recent installation of new tooling machinery, and as a result, many other sizes are now available in square, rectangular and special shaped tubing. The addition of 5-in. tubing gives the firm a range of sizes from $^1/_4$ in. to the new maximum, with wall thicknesses from .028 to .250 in.

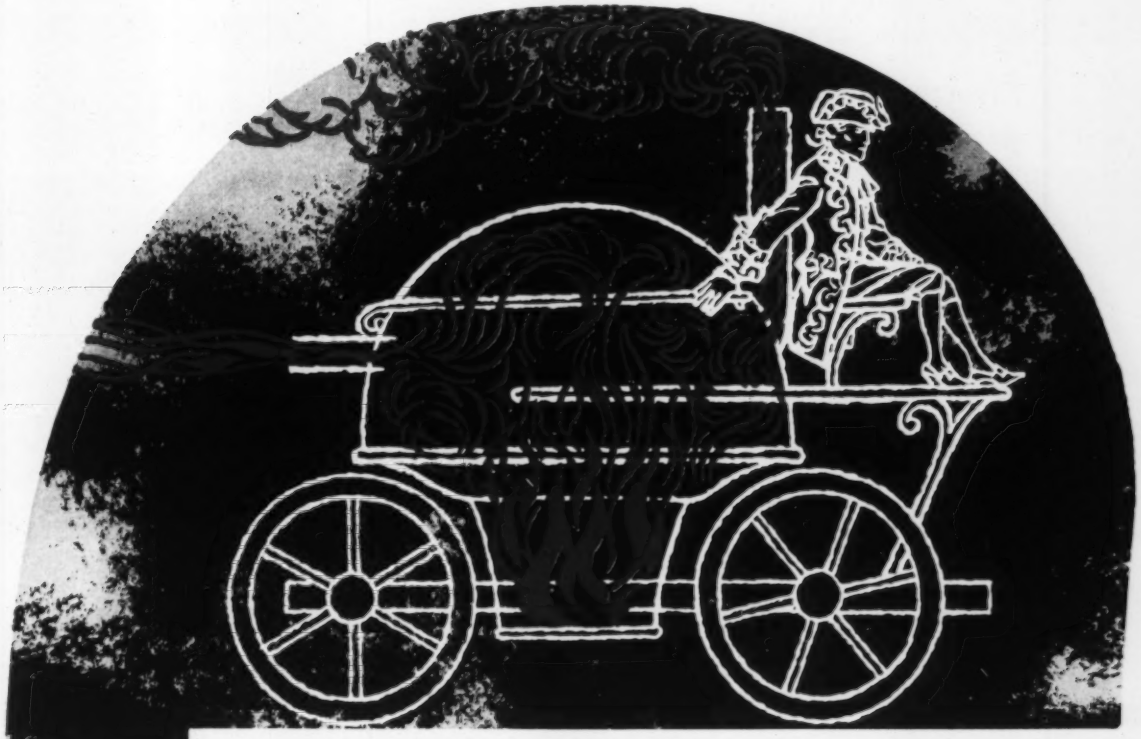
Outside Micrometer

A hole locating and tubing micrometer has been introduced by the Lufkin Rule Co., Saginaw, Mich.

The micrometer has a .089 in. anvil, small enough to enter a $^3/_{32}$ in. ID hole or slot. The anvil is held with a set screw and can be replaced in case of wear or breakage.

The micrometer has a nonglaring chrome clad finish on the thimble and hub, and has a black enameled, heavy duty ribbed, half frame. It has a range of 0 to 1 in. by 1000ths, and is furnished with either a plain thimble or with a ratchet cap. It is priced at $19 for the plain thimble micrometer and $20 with the ratchet cap.

Continued on Page 52



s'Gravesande's Stoomwagen

s'Gravesande's Steam Reaction Car

In 1721 Jacob Willem s'Gravesande of Delft, stimulated by the recently enunciated Third Law of Motion, astounded the Royal Society by constructing a practical steam reaction car. The vehicle actually moved several times its own length, a distance of about two meters.

In 1956 the goal is no longer meters, but hundreds, and even thousands, of miles. Aerojet-General Corporation, leader in American rocket propulsion for more than a decade, is proud to participate in man's first assault on the frontiers of outer space—Project Vanguard.

Aerojet-General CORPORATION

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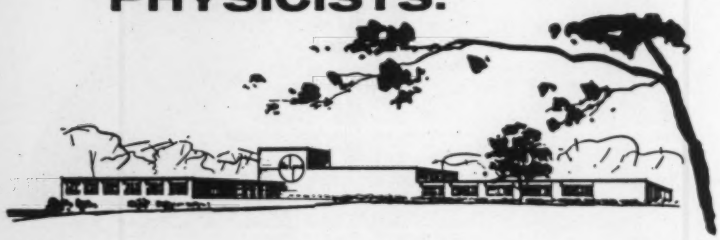
Aerojet-General invites scientists and engineers—men of imagination and vision—to join the attack on the most significant research, development and production problems of our time.

ENGINEERS,

Electronic & Mechanical

PHYSICISTS:



Choose your location when you join Melpar

Melpar's R & D operations are centered near and in two of the country's more desirable communities: Washington, D. C., Watertown and Boston, Massachusetts, each of which affords engineers the opportunity to enjoy research, cultural and recreational resources well above the average.

Regardless of which locale he selects, the engineer will find that our advancement policies and organizational structure provide opportunities uncommon to the industry as a whole.

Individual performance heads the list of factors which determine progress. Regardless of age, experience or tenure, an engineer is given more complex responsibilities *as soon as he is ready*. There is always room to move ahead at Melpar, because we have doubled in size every 18 months for the past 10 years, with a proportionate increase in top and middle level openings.

Our engineers gain comprehensive experience in all phases of engineering problems. Each is assigned to a project team which is charged with responsibility for *whole* problems, from design concept to completion of prototype.

The engineer will find each of Melpar's laboratories splendidly equipped with an eye to both present and future needs. Fully air-conditioned, each laboratory has recently acquired additional facilities.

We extend financial support to those who intend to pursue advanced study. Fully accredited courses are available at our main laboratories.

Write for *complete* information, indicating geographical preference. Qualified candidates will be invited to visit Melpar laboratories at Company expense.

Top Level Openings Exist in These Fields:

Network Theory • Systems Evaluation • Microwave Technique • UHF, VHF, or SHF Receivers • Analog Computers • Magnetic Tape Handling • Digital Computers • Radar and Countermeasures • Packaging Electronic Equipment • Pulse Circuitry • Microwave Filters • Flight Simulators • Servomechanisms • Subminiaturization • Electro-Mechanical Design • Small Mechanisms • Quality Control and Test Engineering

Write: Technical Personnel Representative

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KEEP INFORMED — NEW EQUIPMENT, BUSINESS NOTES, LATEST CATALOGS

Aerosol Valve

A new nylon valve now in production has been designed by Seaquist Mfg. Corp., Cary, Ill., to provide aerosol spray product manufacturers with a foolproof design. According to the company, aerosol producers now can use this one valve for literally hundreds of pressurized products.

Industrial plants spraying oils, rust inhibitors and other protective coatings on products can apply liquids and foams quickly and economically with the 750NN valve, states the manufacturer. The unit is said to be resistant to corrosive products due to its nylon construction and works equally well with noncorrosive chemicals. The valve is said to be usable for many more chemicals than its brass predecessor.

A sealing and retaining ring holds the pressure button firmly on the stem to eliminate the possibility of lost buttons and to prevent seepage between the stem and the button. Three controllable orifices which permit any desired density of spray and uniformity of spray pattern are said to be an exclusive feature of the valve. The same basic design can be used on foam type products.

Portable Rotary Compressor

Ingersoll-Rand Co., 11 Broadway, New York 4, N. Y., announces the addition of a new 85 cfm size to its line of Gyro-flo compressors. With this addition, the firm's line has been increased to six sizes–85 cfm through 900.

The unit weighs 1840 lb fully equipped with tool boxes, fenders and two-wheel spring-mounted running gear. As a truck-mounted unit, it weighs 1375 lb and is only 42 in. high.

The new size is driven by the Continental Motors' F-140 4-cylinder, 4-cycle engine, L head design gasoline engine with push button starting and a 6-volt battery system.

Braking System

Wagner Electric Corp., 6400 Plymouth Ave., St. Louis 14, Mo., announces the addition of a spring-set, hydraulically released parking brake which is manually controlled by the operator and is independent of electric power, to its line of hydraulic brake systems.

The new system, known as type HM-3, is designed to provide service and parking brakes on cranes and other rail guided equipment where an uninterrupted power supply is not available. It is also said to be suitable for use on engine driven equipment.

The system retains the advantages of a powerful and accurately controlled hydraulic service brake and a positive spring set parking brake of proved dependability, the company claims.

The parking brake is released by one application of the control cylinder foot pedal and remains released until manually set by tripping a hydraulic check valve, permitting the service brake to be used as required. A green signal light remains on as long as the parking brake is released.

KEEP INFORMED

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Industrial Teflon Hose

Availability of what is claimed to be the first industrial Teflon hose with detachable, reusable fittings has been announced by Aeroquip Corp., Jackson, Mich. The hose is proposed for applications where unusual exposure to wide temperature ranges and injurious chemical action is encountered.

General applications include steam lines, hot asphalt lines, and other installations with fluid temperatures in the −100 F to + 500 F. The detachable, reusable fitting is leakproof even after aging of hose and may be assembled with hand tools, the firm states. Male pipe and JIC swivel fittings are available.

Nylon Conveyor Belt

A new nylon-filled fabric said to be as strong as steel cable is featured in a new conveyor belt construction announced by B. F. Goodrich Industrial Products, Co., Akron, Ohio.

A belt made with five plies of the new "Nyfil 120-RS" fabric is as strong as a steel cord belt rated at 1000 lb per in. per ply, according to the company. It would take 20 plies of 42-oz cotton fabric to provide the same strength.

The firm said Nyfil 120-RS is a combination of super strength rayon with nylon filler which permits belt operating tensions up to 200 lb per in per ply width.

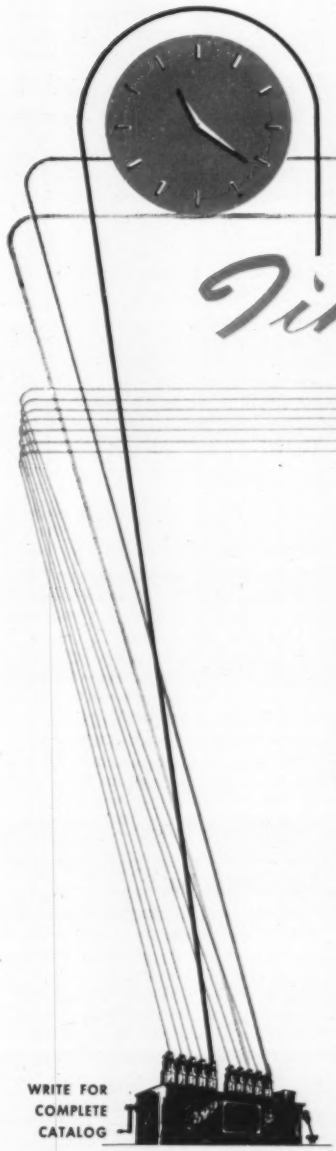
As an example of longer single flights of belting and higher lifts made possible by the new construction, the company said that such a belt—42 in. wide—carrying coal at a rate of 700 tons per hr and traveling 600 fpm can lift its load 852 ft high in a slope length distance, pulley to pulley, of 3290 ft. To cover this same distance and lift with conventional 42-oz cotton fabric, four separate conveyors would be needed, the firm states.

Belts made with resilient nylon filler have exceptional flexibility for better troughing and outstanding resistance to impact, the company said. High strength nylon is said to provide greater crosswise strength in belts and an improved base for holding mechanical fasteners. The belts are available for all industrial uses, both light and high tension, at no increase in cost over conventional fabric-reinforced belts.

Low Pressure Dryer

Kahn & Co., Inc., 543 Windsor St., Hartford 1, Conn., has announced a new series of low pressure adsorption gas dryers designed specifically for such applications as atmosphere control in the metallurgical industry, inert gas generators, pressurizing of coaxial cables and waveguides, elimination of moisture condensation in the manufacture of electrical-electronic components, purging refrigeration components, etc.

The units are completely automatic with twin adsorption towers to assure a continuous flow of dry gas at dewpoints of −50 F or lower. Explosion proof construction is available for hydrogen service.



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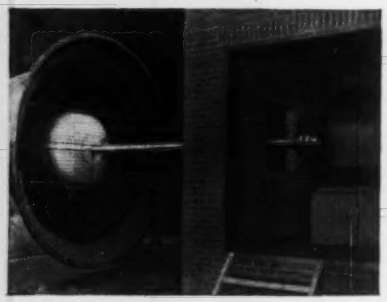

By using Thomas Flexible Couplings on long, unsupported shafts, intermediate bearings are eliminated. Thomas engineers tubular shafts free from lateral whip.

The large fan shown above is 16′ from the motor to allow sufficient air intake. Miners working underground receive their fresh air supply from this fan and others like it, which have been giving dependable service for as long as fifteen years . . . without shutdowns for lubrication or maintenance of the couplings.

Thomas floating shaft flexible couplings are recommended for machine and marine drives, printing presses, paper and cement mills, cooling towers, diesel engines, pumps, compressors, and many other uses.

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Write for Engineering Catalog 51A

THOMAS FLEXIBLE COUPLING CO.

WARREN, PENNSYLVANIA, U.S.A.

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Bearing Lubricant

Klingfast 115, a low-viscosity lead-base gear and bearing lubricant for extreme pressure applications, has been introduced by Brooks Oil Co., 934 Ridge Ave., Pittsburgh 12, Pa.

With the lowest viscosity yet developed in the Klingfast series, this new material is said to provide an extremely durable film which is difficult to remove either by gear pressure or gear speed. According to the manufacturer, a thin, yet highly adhesive film of this type does not retard power transmission and allows gear units to work with greater efficiency.

The lubricant is a natural lead-base coating, stable under normal service conditions, with no build-up in viscosity. The material is easily pumped at temperatures below freezing, and low viscosity permits easy starting after shutdown periods. The high polarity of the oil protects metal surfaces from corrosion, the firm states.

Space Heater

A new Summeraire 120 portable space heater is now in production by the Clayton Mfg. Co., El Monte, Calif.

The unit is 16 in. wide and 40 in. long, and can be equipped with a flexible duct for directing the heated air flow to selected areas without heat loss.

Completely automatic in operation, it plugs into any 115 v a-c outlet. Fitted with full safety controls, unit will operate up to 12 hr on one fueling of No. 1 or No. 2 fuel oil or kerosene, the company states.

The model features a completely enclosed flame. It delivers 120,000 Btu's per hr at the rate of 950 cu ft of heated air per min. Its output is up to 150 F above ambient temperatures.

Self-Locking Nut

A flanged hexagon self-locking nut designed with a large washer-type seat for fastening applications involving spring tension, such as compressor motor mountings in refrigerators, has been developed by the Elastic Stop Nut Corp., of America, Union, N. J. The large built-in bearing area of the Type 1994, is said to eliminate the need of individual nuts and special washers in such applications.

During shipment of a spring mounted unit, the nut can be turned down compressing the spring and making a solid mounting which cannot shift, the company says. Upon delivery the nut is backed off to the proper spring tension to float the unit. As a self-locking fastener the unit will remain locked at any desired position on the bolt permitting exact spring tension adjustment.

The base flange against which the spring seats is 1 in. in diameter. A red fiber insert provides the locking feature of the nut and retains it in any position on the bolt despite pressure of the spring or severe vibration. The new flanged self-locking nut is made from steel with a plain or plated finish.

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APL is responsible for technical direction of the Navy's Bumblebee guided missile program. Developments at APL include the first supersonic ramjet, and the missiles TERRIER, TALOS and TARTAR.

A distinguishing feature of the Laboratory is the self-dependence of the professional staff members, who work in an atmosphere of free inquiry and are unhampered by the usual administrative details. Problems are attacked by teams, each of which maintains a fine balance between research and engineering. The team approach allows each member to acquire broad knowledge, find his creativity heightened.

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For additional information write: Professional Staff Appointments

The Johns Hopkins University Applied Physics Laboratory

8607 Georgia Avenue, Silver Spring, Md.

KEEP INFORMED

NEW EQUIPMENT
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Transfer Molding Press

Hull Standard Corp., Abington, Pa., is offering a new completely automatic transfer molding press for thermosetting plastics.

The press, known as Model 99-A, uses general purpose powder which does not require preheating, and standard mold blocks held in place by a standard mold retainer set. The firm say the unit is particularly suited for getting into production quickly and at low cost, on low quantity runs, as in prototype production; and for the economical molding of small parts required for component miniaturization.

Close tolerances in parts to ±0.0005 in. is possible, the company says. More fragile part sections may be molded. Flash is said to be minimized, and finished holes are possible, since core pins can be piloted through to other half of mold.

The unit is described as a fast, air-operated press requiring a 1/3 to 3/4 hp supply of air at 80 psi. The maximum clamping tonnage is 15 tons. Transfer pressure is adjustable to 9000 psi. Maximum parts dimensions (2 cavity mold) are 1 1/8 × 1 1/8 × 7/8 in. Feeder capacity, per cycle, is 0.9 cu in.

Sub-Zero Temperature Cabinets

A sub-zero temperature cabinet, Model WE-2-140 with 2 cu ft capacity with front or top opening for testing of electronic components, cold treatment of metals, thermal contraction and expansion fitting is featured in literature available from Webber Engineering Corp., Dept. SZ-200, Box 217, Indianapolis 6, Ind.

Temperature range is from ambient (110 F) to −140 F. Voltage is 115 or 230, single phase, 60 cycle. Temperature control is visible and adjustable with a temperature range from +150 F to −150 F. Temperature control accuracy is plus or minus 1 F. Unit compartments have full opening access panels.

Pipe Welding Electrode

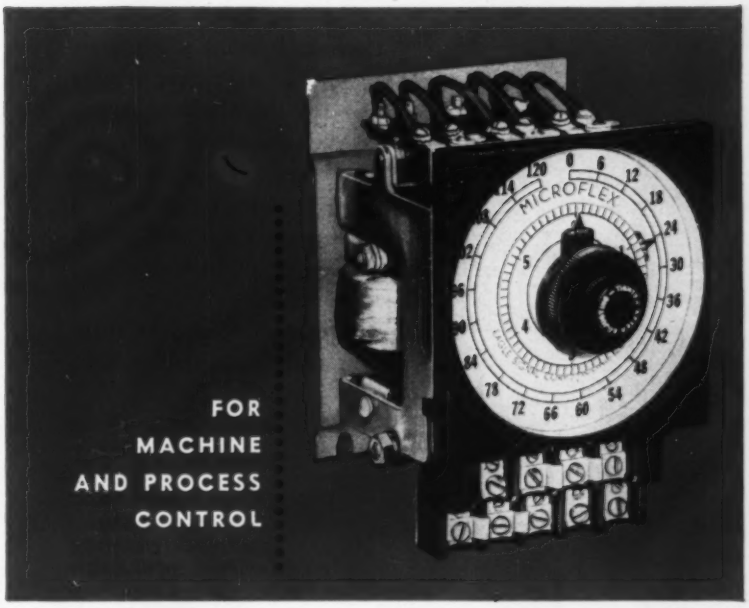
Lincoln Electric Co., Cleveland 17, Ohio, has announced a new E-6010 electrode, Fleetweld 5-P, suitable for all E-6010 applications, but especially designed for pipe welding.

The new electrode provides minimum slag interference, resulting in quick freezing of the molten metal and less tendency for "windows" and porosity, the firm claims. The electrode produces a flat-shaped bead in an even deposit from which slag is easily removed.

Fleetweld 5-P can be used for welding pipe, pressure vessels, X-ray applications, and other ASME code work. It also is suitable for all-position structural welding, machinery weldments and ship welding. It conforms to AWS E-6010 requirements. It has been approved by the American Bureau of Shipping. It is available in 1/8 and 5/32 in. diam.

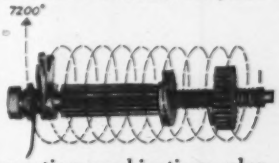
EAGLE

Microflex Reset Timer



Accurate to 1 Part in 1200

Time settings of pinpoint accuracy are a reality, thanks to the Microflex double dial. It takes one complete turn of the *inner* dial to advance the *outer* dial just one division. That's a 20-to-1 ratio, made possible by the patented Microflex threaded axle and pinion (see sketch). Examples of resultant accuracies are ± 1/60 of a second on a 20-second dial, and ± 1/10 of a second on a 120-second dial.



The Microflex Reset Timer is driven by a heavy-duty industrial synchronous motor. Contacts are tripped closed or open after a preset time interval. Starting and resetting are electrically controlled. Microflex offers over 150 timer operating combinations, plus a wide range of long or short time periods. It's ideal for applications like molding presses, dielectric heating, automatic mixing, die casting machines, machine tools and rubber curing.

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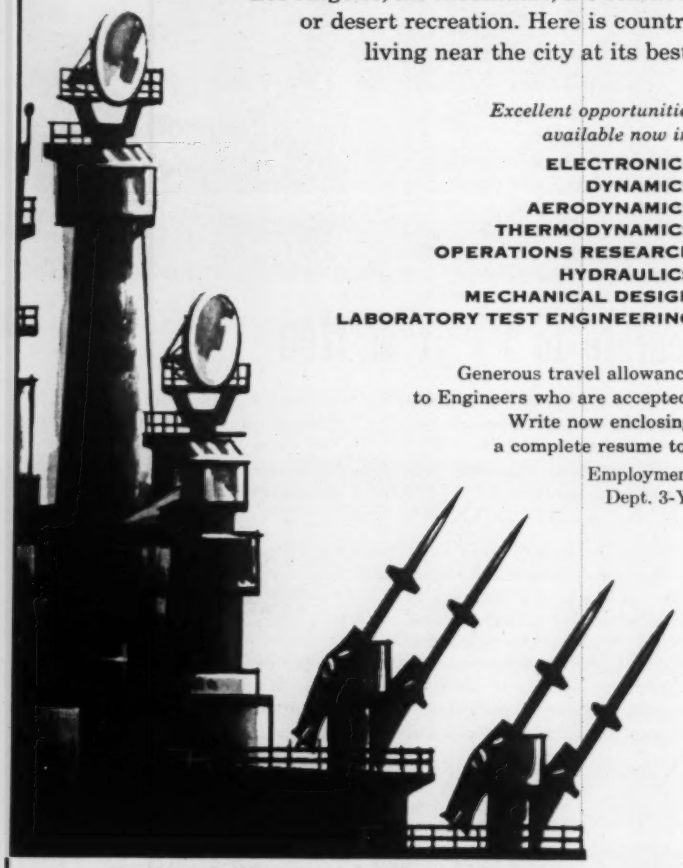

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KEEP INFORMED — NEW EQUIPMENT, BUSINESS NOTES, LATEST CATALOGS

Silver Alloy

A new oxidation-hardenable high silver alloy, said to offer an unusual combination of excellent electrical and mechanical properties, has been developed by Handy & Harman, 82 Fulton St., New York 38, N. Y. The alloy is a silver-magnesium-nickel composition, normally consisting of about 99.53 per cent Ag, 0.27 per cent Mg, and 0.20 per cent Ni.

The firm said the outstanding characteristic of the new silver alloy is that it is easily worked while soft and then irreversibly hardened by heating in air. Once hardened, the alloy is highly resistant to softening, has a low creep rate, and for all practical purposes does not anneal at elevated temperature.

In the as-received (annealed) condition, silver-magnesium-nickel alloy is soft like fine silver or copper, and finished parts can be formed by stamping, drawing, bending, spinning, etc., usually without anneals, the company states. If annealing is necessary, it can be done in 15 to 30 min in air at 700 F or in nonoxidizing atmosphere above 700 F. Permanent oxidation hardening is produced at 1200 to 1475 F, the time and temperature cycle dependent on the thickness of the piece.

In oxidation-hardened condition, the tensile properties at room temperature are similar to those of hard rolled coin or sterling silver. At elevated temperatures, the hot hardness and strength is considerably better than those of hard-rolled silver-copper alloys. However, at elevated temperatures the hardness and strength are accompanied by reduced ductility, and the material tends to fracture rather than creep at excessive stresses.

Swivel Joints

New and more compact swivel joints are now available from Barco Mfg. Co. Dept. J-25, 500 Hough St., Barrington, Ill. Identified as Aircraft-Type Swivels, these joints conform to Mil-J-5513A and other specifications. The firm says their main application is to provide safe and unlimited flexibility in piping or tubing lines in inflight equipment, track vehicles and installations of all kinds.

Two basic types are available with AN flared or "Ermeto" ends in aluminum, steel and stainless steel for pressure up to 4000 psi. The firm says it can furnish either individual joints or complete flexible assemblies of joints and tubing for applications in hydraulic, air, oxygen, fuel, steam and acid service for temperatures from −300 F to +700 F.

The plane swivel joint permits 360 deg rotation in a single fixed plane with starting torque as low as 5 in-lb. Double row precision ball bearings afford swiveling under thrust and radial loads. A tight seal with minimum friction is made by a backup ring and O-ring seal.

The self-aligning swivel joint has 360 deg rotation plus 15 deg total side flexibility to compensate for misalignment and minimize binding wear.

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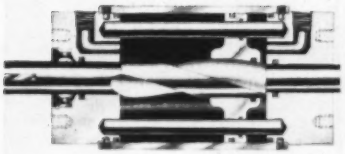


Rotary Actuator

Carter Controls, Inc., 2800 Bernice Rd., Lansing, Ill., says a new concept is incorporated into a line of rotary actuators which depart radically in design and construction from other methods of achieving rotary fluid power.

The new unit is a self contained power unit designed to operate on air, gas, water or oil pressure. It delivers a fast and positive rotary motion by means of a piston and simple internal helix.

According to the company, an almost unlimited number of motion applications are possible with the new actuator, including indexing, positioning, transfer mechanism, valve actuating, ratchets, gate opening, dumping, cam actions, mixing, power take-offs, tumbling, automatic conveyor stops, breech locking, rolling, clamping, and lifting.

The actuator can be stopped at any point in the rotation cycle, and held there indefinitely. There is no by-pass leakage or pressure loss, and because of the internal helix, the work load is firmly held in position and cannot back off under reverse tension, shock, or vibration, even if a complete power loss occurs, the firm states.

The new product is totally enclosed. Through the use of anti-friction thrust bearings it is possible to operate the actuator on pressures from 5 to 500 psi. The actuator is available with built-in valving or with attached pump, motor and reservoir, or all of the foregoing, if desired.

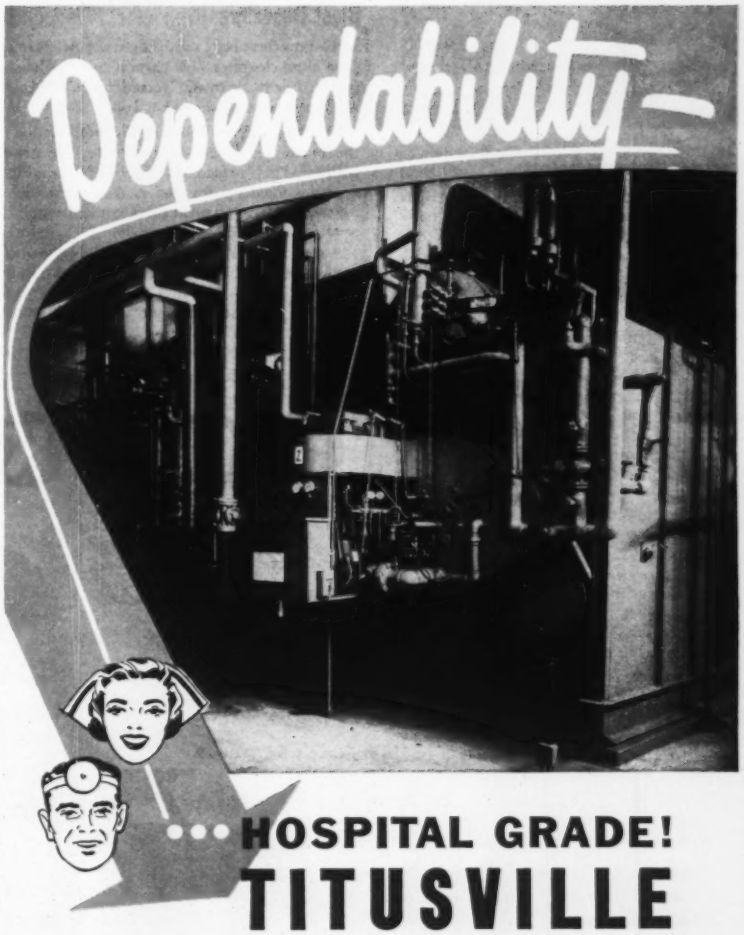
The company is building the actuator in standard sizes of 3, 4, 5, 6 and 8 in. diameters. Standard rotation cycles are: 0 to 100 deg; 0 to 190 deg; 0 to 280 deg; and 0 to 370 deg.

Electrical Symbols Template

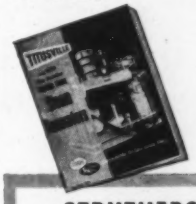
Keuffel & Esser Co., Hoboken, N. J., has added a new electrical symbol template to its Leroy lettering and symbol-drawing equipment that conforms to the new and revised graphical symbols prepared by the American Standards Association.

The electrical symbols are available in three sizes: one as shown in the American Standards Association bulletin; another one half again as large; and a third that is twice as large.

The firm also produces electronic tube symbol templates in the same three sizes. Authorities for both sets of symbols are the ASA Bulletin Y32.2-1954 and military specification MIL-STD-15 A.



Write for your copy of the latest Titusville WTP Catalog



The wide load variations encountered in hospital service are handled smoothly and dependably by the fully automatic, fully modulating features of Titusville's WTP Steam Generator. Shown are two Type WTP #12.5 units, serving a large eastern hospital with high efficiency over the entire operating range.

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Precision Potentiometers

A new line of high temperature precision potentiometers and components that have operating temperatures from −55 C to 150 C, 175 C, or 225 C has been announced by Fairchild Controls Corp's., Components Div., 225 Park Ave., Hicksville, N.Y.

The new line includes wire wound potentiometers in both single and multi-turn types which are rated for continuous duty at 125 C at 3/4 to over 4 watts with 0.1 watt or more at 150 C, depending on size and type. These are available in 7/8, 1 3/4 and 2 in. diameter linear and functional types, and both a ten-turn and three-turn 1 13/16 in. diameter units. A ten-turn 7/8 in. unit will be available shortly.

In addition to wire wound, Fairchild has rotary FilmPots and trimmer FilmPots with an exclusive "Nobl-Ohm" precious metal alloy film resistance element. The rotary types are available in 3/4, 7/8 and 1 1/8 in. diameter. These are rated at 225 C for the 3/4 in. unit and 150 C for the larger units. The trimmer FilmPots are rated to 175 C.

The units are said to have a load life at high temperatures up to and in excess of 500 hours and a rotational life at high temperatures up to 500,000 cycles, or its equivalent for multi-turn units, depending upon specific resistance requirements.

Blast Descaling

Automatic blast descaling is now being used for cleaning low-carbon steel plates prior to deep drawing, according to Wheelabrator Corp., Mishawaka, Ind.

Scale-free steel improves die life, as does the matte finish left on the plate, the firm states. This surface has superior lubricating qualities for deep drawing as compared with that of pickled and oiled stock conventionally used.

Automatic blast descaling employs the airless abrasive blasting principle. Metallic abrasive is centrifugally thrown upon the plate as it passes through a cabinet on a conveyor.

Power Drill Series

Whitman & Barnes, 40600 Plymouth Rd., Plymouth, Mich. offers a series of short length power drills in fractional and wire gage sizes.

These drills are of the same specifications as screw machine drills except for specially designed, heavier webs which are said to make them particularly suitable for use in portable machines. According to the company, the short length power drills will withstand considerable strain and will drill successfully where full length drills may fail. The drills are recommended for drilling truck and auto bodies, sheet metal and stainless steels as well as general purpose drilling.

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For the safest and strongest stairways, insist on *Tri-Lok* or *Tri-Forged* stair treads. Cuts slipping to a minimum, eliminates overstepping. Get complete information on Tri-Lok and Tri-Forged steel grating and stair treads now. Write to

Department D-1209

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These *new* ROCKFORD Clutches and Clutch Plates have been developed by ROCKFORD Clutch Engineers to take full advantage of recently discovered facing material. Actual field tests on heavy duty equipment have resulted in adoption of MORLIFE clutches by builders of tractors, earth movers, graders, shovels, cranes, trucks, oil field equipment and power units. For information how these *new* Rockford MORLIFE Clutches will improve the operation and increase on-the-job hours of heavy duty machines, write Department E.

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CLUTCHES

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NEW EQUIPMENT
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Respirator

Protection against minute particles, including radioactive dust and air-borne organisms, is provided by the new Dustfoe ultra-filter respirator, developed by Mine Safety Appliances Co., Pittsburgh, Pa.

Combining features of the M-S-A ultra-filter respirator with the M-S-A Dustfoe respirator facepiece, the new unit provides maximum comfort along with maximum protection. It weighs only six ounces complete with headband. Used in the respirator is the Type H ultra-filter cartridge, which can remove toxic aerosols, smoke fine dusts, bacteria and certain viruses from air.

The aluminum facepiece can be easily formed by the fingers to fit the contours of the wearer's face. This, plus a carefully designed facepiece cushion, assures an air-tight seal on almost any facial type. The facepiece cushion is made of a recently developed neoprene sponge material which is durable and which will not harden with use. Design of the respirator allows full vision and freedom of head movement. Filter units can be slipped in or out easily for quick changing, or when cleaning the respirator.

For further information, write for Bulletin No. 1004-2 to Mine Safety Appliances Co., 201 N. Braddock Ave., Pittsburgh 8, Pa.

Silicone Defoamer

A new faster acting, more stable silicone defoamer, Antifoam B, has been developed by the Dow Corning Corp., Midland Mich. It is said to be generally effective at concentrations in the range of 3 to 30 parts per million.

Instantly dispersible in aqueous systems, the defoamer may be added without stirring or agitation, the firm says. Because it has extremely small particle size, it also stays in suspension longer. It is said to be ideal for continuous processing, and will not oil out, plate out, settle or precipitate in most applications.

The firm says the material is resistant to heat or cold, and retains its effectiveness even after being literally frozen or boiled.

Tubing Support

A new tube fitting anchor or mounting stud is offered to simplify support of tubing lines by Tube & Hose Fittings Div., Parker Appliance Co., 17325 Euclid Ave., Cleveland 12, Ohio.

The stud is a bolt type adapter made in both the Intru-lok and Triple-lok styles. Intru-lok is the brass, flare-less type tube fittings especially for instrumentation lines of either copper or plastic tubing. Triple-lok is the flare type fittings, made in brass, aluminum, steel and stainless steel.

It is used to mount a tee or cross fitting directly to a bracket or in a threaded boss. The mounting adapter is said to represent a convenience particularly for lead-off locations in banks of tubes or bundled tubes.

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to understudy senior engineer on Light-Gas Gun and other applications. Salary open · New organization. Missiles, initially. Eventually, any or all major physical sciences · Small-company growth opportunity . . . large-company stability · The usual benefits in unusual degree. Suburban Boston · **Required:** M.E. degree or equivalent, preferably with professional registration · **Desirable:** Well-rounded background, feeling for optics and photography, ability to work closely with research scientists of doctorate level · **Write** E. W. Stupack, Room 418G, ARADD, STRATFORD, CONN., or **phone** DREXEL 8-0431.

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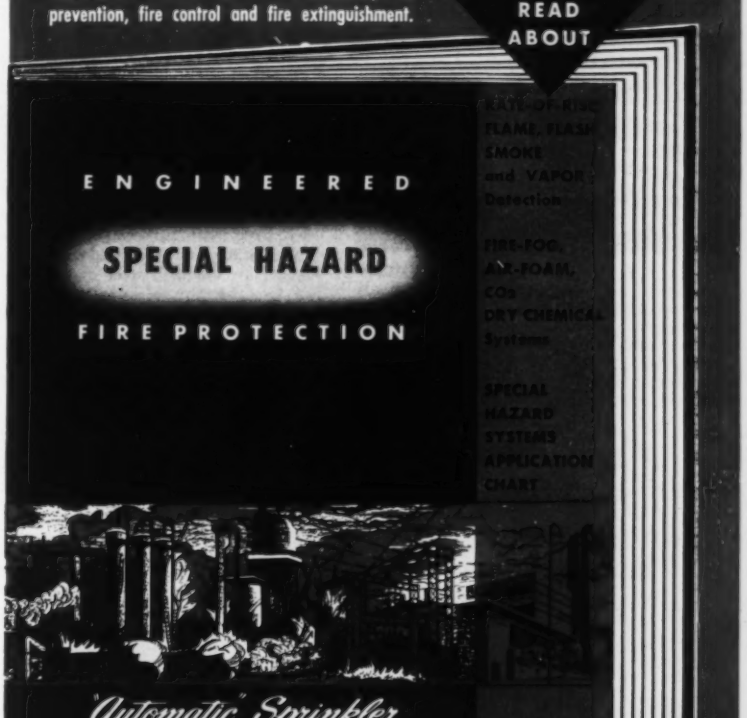

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OUR 70TH ANNIVERSARY 1886—1956

KEEP INFORMED — NEW EQUIPMENT, BUSINESS NOTES, LATEST CATALOGS

Brake Mounted on Crane

Steelweld press brakes made by Cleveland Crane & Engineering Co., Wickliffe, Ohio, can now be obtained with a crane built in, the company announces.

The brake has a 3-ton hand propelled crane with electric hoist made by the Cleveland Tramrail Div. of the company. The crane is 18 ft long and can be traveled as far as 8 ft to the front of the bed center.

The firm says the brake is so large that it is necessary, because of shipping limitations, to provide a detachable bed which is secured to the machine by resting it on saddles at each end and bolting to the frame.

The machine is rated for 20 ft × $^{5}/_{8}$ in. mild steel and will handle 16 ft plates between housings. Two speeds are provided: 7 or 21 strokes per min. Overall dimensions are: Length 22 ft, depth 11 ft, height 17 ft 2 in. The bed extends 3 ft 8 in. below the floor.

Nylon Bearings

A line of straight and flanged nylon bearings available in 39 sizes ranging from $^{1}/_{4}$ to 1 in. ID is announced by Climax Metal Products Co., 863 E. 140 St., Cleveland, Ohio.

Said to be suitable for all shaft applications where reciprocating, oscillating or rotating motion is involved, the bearings are recommended for use with steel shafts and may also be used with brass or bronze shafts. The bearings are reported to support loads in excess of 206 lb psi at rubbing velocities of 525 fpm.

The single overall limiting factor that determines the maximum capacity of a given bearing installation is the equilibrium temperature at the bearing face under operating conditions. Load and speed limits can be extended by dissipating frictional heat, either by use of ample lubrication or by design of the bearing and mounting, the manufacturer states.

The bearings may be used with no lubrication. According to the manufacturer, the nylon bearings are particularly suited for heavy loads at low rpm, for light loads at high or low rpm, and in the foregoing applications where lubrication is a problem. Due to the surface-glazing effect of nylon in rubbing contact, abrasive particles do not adversely affect the bearing qualities of the nylon material. The bearings are said to be particularly suited for use in chemical and food process equipment. In this service, the fluids serve as heat transfer agents to maintain bearing temperatures below the equilibrium point.

ID bearing tolerances are held to .005 in. over shaft size, ±.001 in., the manufacturer states, while OD is held to .004 in. over the fractional size, ±.001. These tolerances, it is pointed out, allow a press fit in the housing with proper running tolerances for general purposes. Closer tolerances, however, may be obtained by reaming the housing hole under size. These bearings are also available in special length to order.

ENGINEERS

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SERVO ENGINEERS

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Milwaukee 2, Wis.

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Mr. John F. Heffinger
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Milwaukee 2, Wis.

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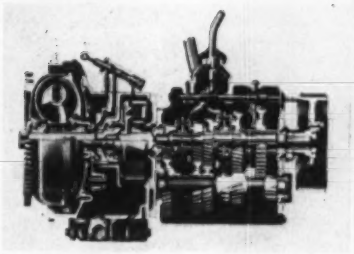
LATEST CATALOGS



Power Train

Compact size, simple components, easy installation and long service life are claimed to be the features of the "TransVerter," a new power train package developed by Clark Equipment Co., Transmission Div., Jackson, Mich.

Rated for engine torque output of up to 325 lb-ft, the unit consists of a torque converter, hydraulic disconnect clutch and standard transmission in one unit ready for mounting with any standard engine. The unit is 8 in. longer than a conventional transmission and clutch.

Designed specifically for off-highway and stop-go operations, the unit is said to be particularly suitable for equipment such as house-to-house delivery trucks, busses, garbage trucks and construction equipment.

The company says operational advantages of the new power train include elimination of engine stalling and lugging; sharp reduction in gear shifting to the point where most work can be performed in the same gear; and fine inching control by simply working the throttle. Provision is made for SAE power-take-off attachments, to be driven by the torque converter.

The hydraulic disconnect clutch is an on-off type unit that does not require "letting in," or "easing." As a result, any one of a variety of clutch releases can be provided, including shift lever button or even a conventional-looking pedal raised slightly from the floorboard.

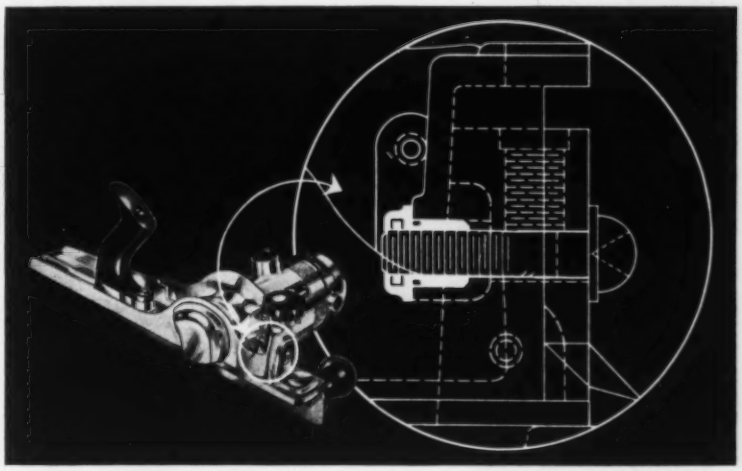
Transducer

Detection of small flaws close to the specimen surface by ultrasonic echosounding methods is now said to be possible with a new high resolving transducer announced by the Industrial and Scientific Products Div., Curtiss-Wright Corp., Caldwell, N. J.

The firm says the high resolution transducer has the ability not only to locate a flaw closer to the specimen surface than its quartz counterpart, but also to differentiate between two defects in the same minute area.

When a ten Mc/s, $^3/_4$ in. diameter, high resolution transducer is used with a suitable instrument it is possible to detect a round plane flaw 0.0017 sq in. area at a distance of 0.1 in. below the top surface of an aluminum specimen. By comparison, a quartz crystal transducer would be able to "see" such a flaw only up to 0.3 inch from the surface, the company says.

FASTENER PROBLEM



Eliminating double-drilling and tapping of cast parts

On the Stanley Power Plane, a screw is used to provide clamping and adjustment for depth of cut. Threads to receive this locking screw are in a relatively inaccessible section of the casting. A tapping operation in assembly would be slow and costly.

An ESNA Spline type nut solves this problem. It is simply pressed into a cored hole in the casting. No hole preparation or tapping is necessary and substantial savings in production costs result.

The Spline type Elastic Stop® nut has a straight knurled cylindrical shank as an extension of the main body of the nut. Pressed into a soft metal casting, the splines serve as a broach to make the nut self-retaining. The red ESNA locking collar provides a positive lock for the adjusting screw. It permits precise adjustment that won't be disturbed by vibration or jolting . . . particularly important in maintaining adjustment in applications like this. And it can be re-used many times.

Whatever your fastening problem, it will pay you to find out how ESNA can help you solve it.

MAIL COUPON FOR DESIGN INFORMATION

Dept. N2-911, Elastic Stop Nut Corporation of America
2330 Vauxhall Road, Union, New Jersey

Please send me the following fastening information:

☐ Bulletin on Spline type Elastic Stop nut.

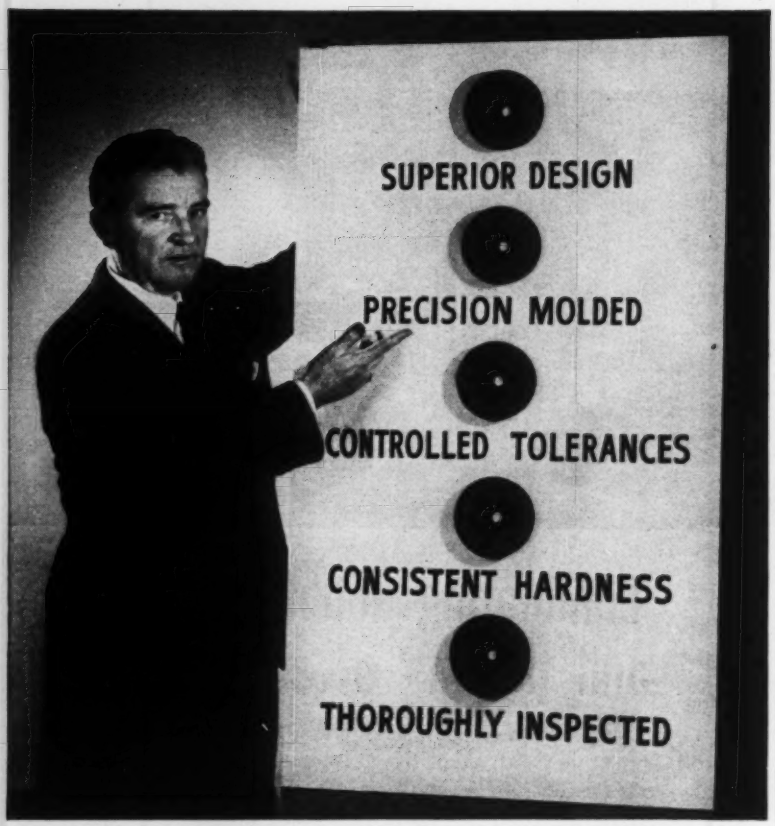
☐ Here is a drawing of our product. What self-locking fastener would you suggest?

Name _____ Title _____

Firm _____

Street _____

City _____ Zone ____ State _____



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The general outward appearance of R/M Fabric Piston Cups—clear definition of contours, smooth surfaces, clean trimming—is evidence in plenty of top-flight precision molding practice. Accurate, carefully controlled, this assures dimensional uniformity and therefore maximum sealing effectiveness.

Cut an R/M Fabric Piston Cup apart and you will see the purpose for R/M's special impregnation method — deeper, more thorough penetration of the compound into the fabric. This keeps wicking action from destroying the cup internally. It also builds up greater resistance to ply delamination.

R/M Fabric Piston Cups are thoroughly inspected, hardness is consistent, and they adhere strictly to industry standard sizes. To meet your requirements, R/M engineers will recommend the proper combination of asbestos or other strength member with rubber-like synthetic composition to best meet temperature and pressure conditions.

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R/M's line of molded hydraulic and pneumatic packings includes:

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RAYBESTOS-MANHATTAN, INC.
PACKING DIVISION, PASSAIC, N.J.

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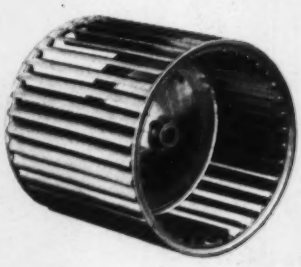

Blower Wheel

A new center-disk blower wheel introduced by Torrington Mfg. Co., includes an exclusive structural feature to eliminate looseness, blade rattling and blade-angle warp.

The new design permits operation of the firm's Type CL Airotor at higher speeds than conventional blower wheels. The structural center disk of the blower wheel is dovetailed under pressure into the encircling blades, forming a compression fit. As a result, this interlocking joint tightens during rotation, the company says.

The new Airotor is available in six sizes: $9^1/_2$ in. dia. ($7^1/_8$ and $9^1/_2$ in. widths), $10^5/_8$ in. dia. (8 and $10^5/_8$ in. widths), and $12^{\ 5}/_8$ in. dia. ($9^1/_2$ and $12^5/_8$ in. widths). Detailed technical information may be obtained by writing Air Impeller Div., Torrington Mfg. Co., Torrington, Conn.

Telemetering System

A new system of telemetering instruments which will totalize several flow measurements, correct for such factors as temperature, pressure, specific gravity and supercompressibility in fluids, and which will provide a corrected flow value, has been announced by Bristol Co., Waterbury 20, Conn.

This system of telemetering transmitters and receivers, and electronic self-balancing instruments can be used wherever corrected flow values are vital for proper operation, the company states.

The instruments can also be supplied in a variety of types to perform averaging, totalizing, multiplying, and dividing computations involving the basic measured variables listed above. In addition, systems will extract square root values, obtain the square of the reading, or compensate for a particular mathematical law can be supplied.

In a typical system, indicating or recording telemeter receivers retransmit the uncorrected flow values to a totalizing electronic instrument. At this stage, corrections for static pressure, temperature and specific gravity are made, either by signals from other Metameter transmitters or by manual settings, and the corrected total is recorded and integrated if desired.

Continued on Page 65

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1	17	30	45	60L	73L	85	99	115–16	135	146	159L	165L
2	18	31	46	61	73R	86	101	119	136	147	159BR	166T
3	19	32	47	62	74L	87	103	121	137	148	161T	167
4–5	20–21	33	49	65	75	89L	104–5	123	138	149	161B	168–69
6–7	22–23	34	53	67	77	89TR	106	125	139	150	162L	193
8–9	24	35	54L	68	78	89BR	107	127	140	151	163TL	195
10–11	25	37	55	69	79	92L	109	129	141	152	163TR	197
12	26	39	57	70	80R	92R	110	130	142	153	163B	IBC
13	27	40	58L	71TL	83L	94–95	111	131	143	154	164L	OBC
14–15	28	42	58R	71R	83R	96	113	132	144	155	164TR	

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3	19	32	47	62	74L	87	103	121	137	148	161T	167
4–5	20–21	33	49	65	75	89L	104–5	123	138	149	161B	168–69
6–7	22–23	34	53	67	77	89TR	106	125	139	150	162L	193
8–9	24	35	54L	68	78	89BR	107	127	140	151	163TL	195
10–11	25	37	55	69	79	92L	109	129	141	152	163TR	197
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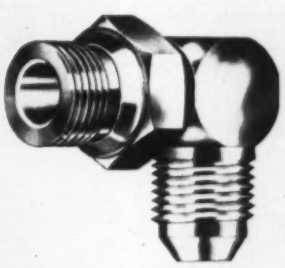


Straight Thread Fitting

L & L Mfg. Co., Van Dyke, Mich., introduces its new elbow shape, "CN" captive nut straight thread fitting to provide positive seal of hydraulic fluids without the use of an O-ring.

The firm says impartial field tests have successfully substantiated that the unit is highly resistant to vibration and intense heat; eliminates stress, elbows and tees can be positioned without overtorque of threads; reduces installation time; prevents costly downtime, no need for sealers in hydraulic system; fitting can be assembled and reassembled without damage to port or fitting.

The elbow shaped straight thread fitting allows minimum 405 deg. for positioning in port. Tolerances are said to be liberal, and port contour is a 30 deg angle, machined into drilled hole before tapping.

Other features include burnished seats, induction toughened tube outlets, radius corners, sufficient stock to tap for gage line connections and large, flat wrench areas.

Solid Shaft Motor

A newly designed vertical solid shaft motor, conforming to dimensional standards recently adapted by NEMA, has been announced by U. S. Electrical Motors Inc., Box 2058, Terminal Annex, Los Angeles 54, Calif.

Designated as Uniclosed, Type HV, the new motor is said to be more compact than previous motors for its horsepower rating. The new motors are now available from 1 to 10 hp and will soon be available up to 30 hp. The motors are furnished with a NEMA style "C" or style "P" base. Type HV vertical shaft connection for directly applied power simplifies hookup and unitizes the motor with the driven machine to insure positive alignment and quiet operation.

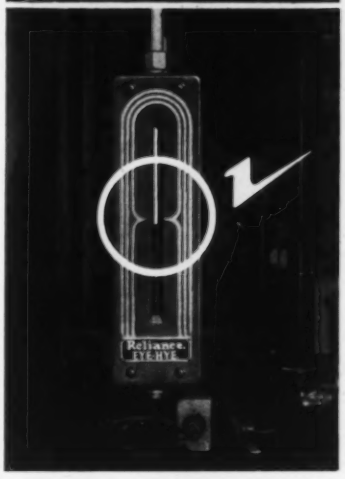
The motor frame, brackets, canopy cap and outlet box are designed of cast iron. The frame is heavily ribbed inside to accommodate the moisture-resistant prewound stator. Another feature is the normalizing operation which is a heat-seasoning treatment to eliminate internal molecular stresses in motor castings. The firm says this treatment prevents distortion of bearing alignment, warping, and insures the correct air gap between the rotor and stator. Each rotor is scientifically balanced by electronic method to correct for any weight imbalance.

Two watch dogs... twice as good as one...

Let the Reliance Safety Team give you a double check on boiler water levels

Sound Check Alarm Water Column

Sight Check EYE-HYE Remote Gage



This team works for thousands of plants like yours. It double checks boiler water levels—helps you achieve more efficient operation, lower power cost, greater safety. The sensitive float-operated mechanism in the Alarm Water Column sounds a last-resort warning (see whistle) when water approaches low or high danger points. But for minute-by-minute scanning by operators, EYE-HYE beams its bright picture of true water level condition from a convenient eye-level position. It's the original remote reading gage — all-hydrostatic, simple, sure.

Now... alarms on pressures to 2500 lbs.!

Steam whistles are available on Reliance water columns up to 900 psi only. But with the Reliance Levalarm EA17 you can have vibratory horns or warning lights or both, to assist EYE-HYE in water level "watch dog" service. It pays you to have the Reliance Safety Team for adequate boiler water level supervision. Write for details — or ask your Reliance Representative.

The Reliance Gauge Column Co., 5902 Carnegie Ave., Cleveland 3, Ohio

The name that introduced safety water columns.... in 1884

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BOILER SAFETY DEVICES

To the *creative* engineer...

AiResearch two stage lightweight gas turbine compressor provides pneumatic power for aircraft main engine starting and serves as auxiliary power source for a variety of ground and in-flight services.

The rapid scientific advance of our modern civilization is the result of new ideas from creative minds that are focused on the future. Our engineers not only have ideas but have the ability to engineer them into products.

That's why The Garrett Corporation has grown in both size and reputation to leadership in its areas of operation. That's why we are seeking more creative engineers to help us maintain and extend our leadership. If you fall in that category, you'll find working with us fulfilling in stimulation, achievement and financial rewards.

All modern U.S. and many foreign aircraft are Garrett equipped. We have pioneered such fields as refrigeration systems, pneumatic valves and controls, temperature controls, cabin air compressors, turbine motors, gas turbine engines, cabin pressure controls, heat transfer equipment, electro-mechanical equipment, electronic computers and controls.

We are seeking engineers in all categories to help us advance our knowledge in these and other fields. Send resume of your education and experience today to: Mr. G. D. Bradley

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KEEP INFORMED — NEW EQUIPMENT, BUSINESS NOTES, LATEST CATALOGS

Pipe Joint Tape

L.O.F. Glass Fibers Co., 1810 Madison Ave., Toledo, Ohio, reports that it has introduced a new coated tape for field wrapping of joints and fittings on underground pipe lines which is comparable to the coating used in the overall wrapping operation.

The company had been offering a product called Duratape, which is a glass fiber mat coated on both surfaces. Previously, however, Duratape was coated only with coal tar. The new product coating is asphalt.

Chemical Process Pumps

For pumping most all chemical process liquids, either hot or cold, in moderate capacities against low, medium or high heads, with special emphasis on a complete interchangeability of pump components, Peerless Pump Div., Food Machinery and Chemical Corp., 301 West Ave. 26, Los Angeles 31, Calif., has introduced new chemical process pumps designated as Type DL and Type DM.

They are available in discharge sizes from 1 through 4 in. Enclosed or open impeller design is optional construction. Capacities up to 800 gpm are provided. The firm says the pumps will operate against heads to 400 ft. Driver can be a standard, horizontal, electric motor mounted on common base with pump.

The new pumps, it is stated, are offered in two basic designs: one, grease lubricated; the other, oil lubricated. Either is available with enclosed or open impellers. Standard bearing construction for operation at temperatures to 250 F is grease lubricated. Above 250 F to 400 F oil lubricated construction is used. The latter construction is also available for pumps handling liquids to 250 F. In and out cooling connections in the oil lubricated design maintain oil supply in reservoir at proper temperature. Provision is also made for water cooling the packing. The pump case is tapped for in-and-out water cooling connections for temperatures to 400 F. Where a positive seal is desired, the pumps can be equipped with mechanical shaft seal of standard design and manufacture.

Grinding Mill

An improved ball and pebble mill, stated to bring a new standard of precision and efficiency in fine grinding to a broad cross-section of industry, is announced by Patterson Foundry & Machine Co., East Liverpool, Ohio.

A brochure, available from the company, covers the outstanding features that are claimed to give this equipment unexcelled ability to grind materials with maximum efficiency, at lower cost, and with enhanced operator convenience. Among the advantages are a new accurate water temperature control; 20 per cent greater jacket area plus higher water velocity; special corrosion control in water jacket; motor drive integral with mill stand; heavy duty anti-friction bearing assembly; safety guardrail.

KEEP INFORMED

NEW EQUIPMENT
BUSINESS NOTES
LATEST CATALOGS

Metal Chip Transfer

Automatic transfer and storage of metal chips and similar scrap materials is provided by a new handling system composed of vertical and horizontal conveyors plus a scrap storage bin, according to an announcement from Gifford-Wood Co., Hudson, N. Y.

The system is designed to provide fast, automatic transfer of scrap through non-production plant areas. At its initial installation the new system saved the company almost 100 man days a year in production and transfer time, the firm reports. It also eliminated transfer lines through production areas and automated an old-fashioned manual handling operation.

The conveyor system consists of an automatic, 6 cu ft bucket-type skip hoist conveyor housed in a special shaft, which conveys scrap vertically from the production area; an enclosed hinged-pan type conveyor, for horizontal delivery to a storage bin; and necessary interlocks between the two conveyors, and between the pan conveyor and the bin, for necessary transfer, delivery and control.

Variable Speed Drive Unit

A new line of variable speed drives is being introduced by Foote Bros. Gear and Machine Corp. Called Vari-Mount, the units feature standard, interchangeable components and are designed to accommodate standard motors. Capacities range from 1 to 15 hp with maximum speeds of 711 to 15.1 rpm and minimum speeds from 355 to 2.5 rpm. Speed adjustment ranges are available up to 6:1.

By using standard Foote Bros. Line-O-Power reducers and various standard motor speeds, units can be individually tailored to produce almost any desired speed, power and reduction ratio. Vari-Mount is available in vertical or horizontal models and can be operated by remote or manual control.

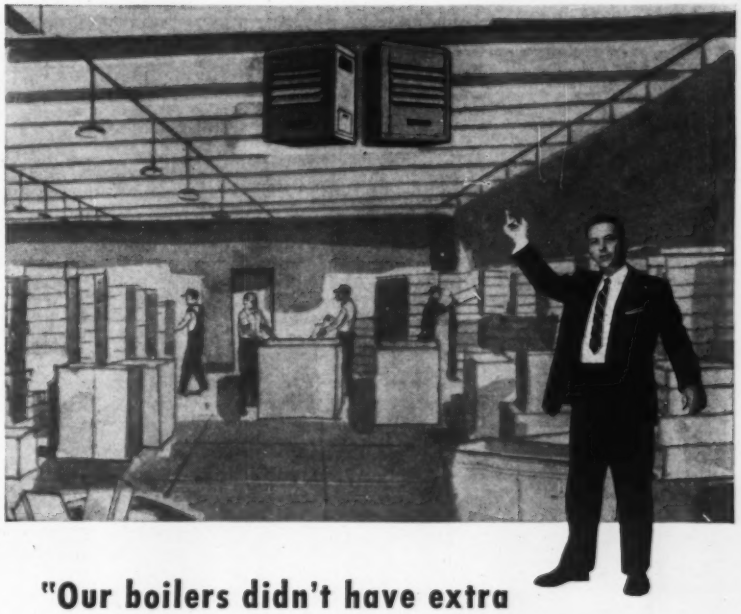
For further information, contact Foote Bros. Gear and Machine Corp., 4545 S. Western Bld., Chicago 9, Ill.

Side Shifter Attachment

Lamson Mobilift Corp., Syracuse 1, N. Y., announces a side shifter attachment available for the firm's line of stand-up and sit-down industrial trucks.

The new design provides a full 8 in. of travel, and is compact and light so there is an almost negligible loss in truck capacity. A double acting hydraulic cylinder provides a full 4 in. of travel either side of the center position.

Full length bronze wear plates have replaced anti-friction bearings to provide a full length bearing surface and add only a fraction of an inch to the length. The design maintains the open center construction of the fork carriage so that the operator can see through the unit for faster, safer operation.



"Our boilers didn't have extra capacity to handle this plant addition— Reznor heaters were the perfect solution"

"When we completed this new plant addition, our boilers weren't able to take the additional heating load. It wasn't going to be economical to add another boiler, or to replace one of our boilers with a boiler of larger capacity. Reznor heaters were the perfect solution for our problem. Eighteen 150,000 BTU Reznor heaters give us the required capacity and they maintain even, comfortable temperature throughout the new section of the plant. Installation costs were surprisingly low. Operating costs have been less than that for the same capacity from the steam system, and we've had absolutely no maintenance work to do. When our present boilers need replacement, we'll probably switch the whole plant to Reznor gas unit heating."

Only Reznor Gas Unit Heating Offers All These Advantages

- Low Equipment Cost
- Low Installation Costs
- Low Operating Costs
- Instant Response to Every Change in Temperature
- No Maintenance Problems
- Waste No Floor Space
- Extra Heat for Trouble Spots
- Complete Adaptability to Future Construction

For more information mail the coupon below or call your nearby Reznor distributor. He's listed under "Heaters-Unit" in the yellow pages of your telephone directory.

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THE WORLD'S LARGEST-SELLING GAS UNIT HEATERS

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☐ Please send me my free catalog on Reznor gas heating equipment.
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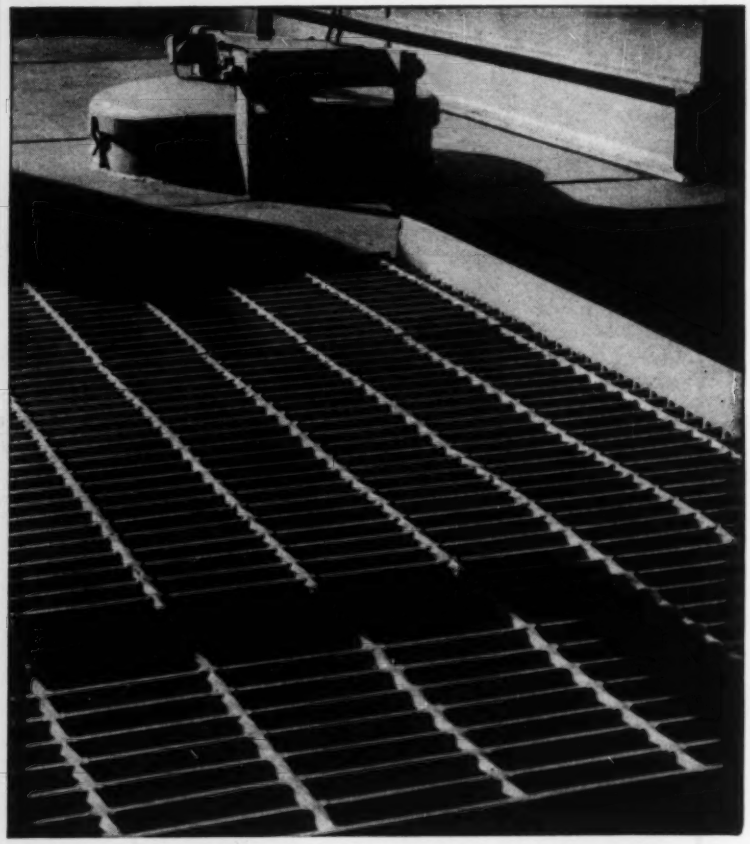

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Indoors or outdoors, you can provide safe walking conditions throughout your plant on floors, stair treads, platforms, walkways and catwalks. For Blaw-Knox Electroforged Steel Grating brings you these exclusive features:

1. rigid one-piece construction—easy to install
2. non-slip twisted crossbar—for safe footing
3. three types of bearing bars
   - square bars—for smoothest walking surface
   - knurled bars (Furro-Grip)—for extra safety plus relatively smooth walking surface
   - serrated bars—for maximum safety under extremely hazardous skid conditions
4. no sharp corners to clog—self-cleaning
5. all surfaces accessible—easy to paint
6. maximum open area—for light and ventilation

Write for your copy of new Bulletin No. 2486
—or send dimensional sketch for quotation.

50th Anniversary BLAW-KNOX 1906-1956

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BLAW-KNOX EQUIPMENT DIVISION

Pittsburgh 38, Pennsylvania

GRATING APPLICATIONS: floors • platforms • walkways • catwalks • stair treads • fan guards • shelving • and many other uses, both outdoors and indoors, for versatile steel grating

KEEP INFORMED — NEW EQUIPMENT, BUSINESS NOTES, LATEST CATALOGS

Direct-Writing Oscillograph

A new, two-channel, direct-writing oscillograph which provides instantaneous, permanent recordings of frequencies as high as 250 cps at one-inch double amplitude has been announced by Consolidated Electrodynamics Corp., 300 N. Sierra Madre Villa, Pasadena, Calif.

This equipment, consisting of a Type 5-301 datagraph and a Type 1-133 amplifier, can record voltages from practically any source, including magnetic-tape playback units, carrier amplifiers, audio amplifiers, d-c amplifiers, and telemetering discriminators, the company says. Almost any input device is said to be suitable because of the instrument's high input impedance. In addition to frequency response flat to 250 cycles, datagraph has excellent square-wave and transient response.

The datagraph employs a vibrating wire in a strong, specially shaped magnetic field provided by a permanent magnet. The wire burns a contact wherever it touches the electro-sensitive paper as it travels over an anvil, providing rectilinear writing. The record may be seen through a viewing window immediately after it is recorded.

Since the recording system uses no ink, traces are clean and can be interpreted easily. Speed-change pushbuttons select six chart speeds from 0.05 to 20 in. per sec, and separate control knobs set the trace density for each of the two channels. Timing pulses are provided automatically at one pulse per sec, or up to five pulses per sec by external means. A manual "event marker" pushbutton can be used to mark the chart at any time.

The oscillograph and the amplifier are each $9 \times 10^1/_2 \times 17$ in. and weigh 60 and 50 lb respectively. They operate on 105– to 125-volt, 60-cps a-c.

Farm Equipment Motors

Two new single phase motors designed from test information and actual farm installations have been introduced by The Peerless Electric Co., Warren, Ohio.

The repulsion-induction motor is not harmfully affected by extremely low voltages and will operate satisfactorily without damage to the motor, the firm states. Brushholder parts are of aluminum, copper and stainless steel or bronze. A built-in, manual reset, thermal overload protector prevents burnouts. The motor is manufactured in sizes from 1 to $7^1/_2$ hp and is recommended by the company for duty on silo unloaders, barn cleaners, milking machines, feed grinders, ensilage cutters, elevators, conveyors.

The capacitor motor is designed for applications where equipment operates continuously on such equipment as ventilating fans, crop driers, grain and hay blowers, irrigation pumps, refrigeration compressors. The motor is manufactured in sizes from 1 to 15 hp.

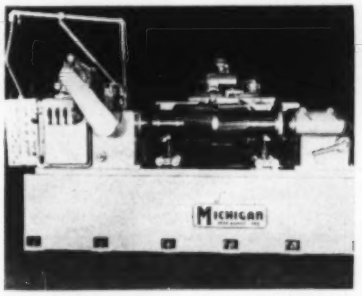
KEEP INFORMED

NEW EQUIPMENT
BUSINESS NOTES
LATEST CATALOGS

Hydraulic Governor

A newly-designed hydraulic governor, Class 3300, has been announced by Farris Pickering Governor Co., Inc., 612 Commercial Ave., Palisades Park, N. J.

The new governor is said to feature full work capacity with complete regulation over the full range of speed settings for constant speed governors. Its rated work is 123 in.-lb, and rated torque is 159 lb-in. Steady state stability is better than 0.1 per cent, the company says. Isochronous or speed-droop characteristics are obtainable by manual adjustment. Adjustments provided include speed changer, steady state speed regulation, first compensation relay, second compensation timing valve, rate of response and load limit throttling. A fail-safe flexible drive is said to dampen speed variations without affecting performance.



Shaving Machine

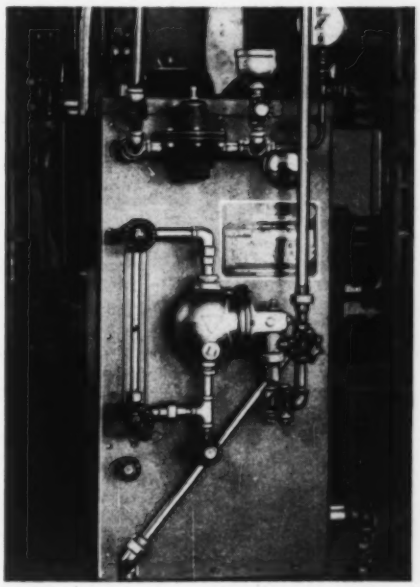
Development of a special shaving machine for finishing large pinions such as those required by turbines used in large seagoing vessels and power generating plants is announced by Michigan Tool Co., 7171 E. McNichols Rd., Detroit 12, Mich. Finishing rate possible with this large shaver is 10 to 15 times as fast as was possible with former methods, the company claims, adding that this reduction is achieved despite the fact that the machine is designed for extreme precision due to high cost of parts being finished.

The machine is said to be extremely versatile and can shave a gear located any place on a 100-in. shaft. Dual shaving cutters can be used when pairs of gears are located close together as shown in the above illustration.

A total of 32 push-buttons are provided on the pendant control box to control spindle speed selection, fast or slow in-feed, cycle start and stop, fast and slow traverse feed. The control box is mounted on a pivoting bracket so that the operator has machine controls at his fingertips at all times, whether he is at the front, side or back of the machine.

Among the special features available on the unit are hydraulic lift jacks that raise the extremely heavy workpiece into position for mounting between centers and for supporting the finished workpiece when unloading.

Pantex Speedylectric Steam Generator



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Ideal Steam Source for Pilot, Lab and Test Work

permits precise control of pressure and quality . . . eliminates operator, odor, fumes, fire hazard

Industry uses this "extra" steam boiler in many ways to facilitate production, reduce costs and eliminate fire and explosion hazards. For pilot operations, laboratories and tests the Speedylectric Steam Generator often proves the only answer to steam needs.

It can be installed right in a laboratory, for it requires little space and practically no attention or maintenance. It is silent, odorless, free from fumes and hazards of fire or explosion. It exactly and automatically maintains any desired pressure, and constant quality 98 per cent dry steam. Utilizing the Speedylectric electrode principle, it generates steam electrically, at surprisingly low cost. Capacities from 2 to 60 Bhp; 15 to 500 Psi; for 220, 440, 550 volts AC. USE COUPON to get complete details.

Speedylectric Steam-Jet Cleaner lets one man do the work of five. High pressure jet of dry steam and solvents quickly removes grease and dirt accumulations from machines and equipment *without* flooding floors. No need to stop nearby production or move machines outside. Completely safe and portable.

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Send me facts and figures on:

☐ Pantex Speedylectric Steam Generator
☐ Pantex Speedylectric Steam-Jet Cleaners

Name and Title.....

Company.....

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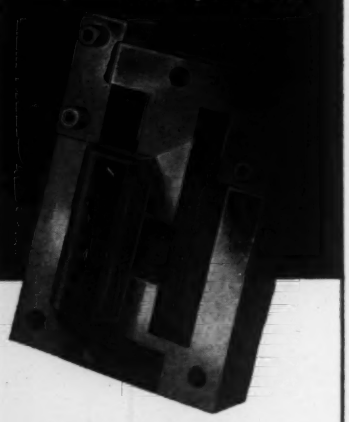

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National Acme Solenoids will make *your job* easier—because they do *their job better!*

1. ***Made in Push and Pull types—within sizes ranging from 2½ to 21 lbs. at ½-inch stroke—to 2 to 25 lbs. at 1-inch stroke.***
2. ***Rugged enough for the heaviest type of duty.***
3. ***Compact—especially suited for limited space service.***
4. ***Non-magnetic retainers.***
5. ***Available with terminal blocks and variety of standard mountings.***

Send for complete details in BULLETIN EM-52—or discuss your design problem with our representative.

Electrical Manufacturing Division

National Acme

The National Acme Company
192 East 131st Street, Cleveland 8, Ohio

KEEP INFORMED — NEW EQUIPMENT, BUSINESS NOTES, LATEST CATALOGS

Gas Turbine Unit

Development of a new model small gas turbine unit with a 100 hp rating has been announced by Garrett Corp. AiResearch Mfg. Div., Phoenix, Ariz.

Compact to the point where it could be inserted in a standard size duffel bag and weighing only 175 lb, the turbine model GTP70–10 is designed as a power unit for driving airborne or ground support a-c or d-c generators, liquid pumps and alternators and has marine applications for hydraulic pumps. Other applications can be adapted for mounting on jeeps, trailers, boats or aircraft as an auxiliary power unit, the firm states.

It provides a source of constant-speed shaft power when installed in ground support equipment or while airborne at altitudes up to 50,000 ft, the company says. While using a single synthetic lubricant the gas turbines will operate throughout the entire temperature range from −65 to 130 F.

The unit has a two-stage centrifugal compressor, a single stage radial-inward-flow turbine and an output shaft speed of 6000 rpm.

Starting, acceleration and running sequence of the unit is controlled by a completely automatic and coordinated system of pneumatic and electro-mechanical controls which are integral with the unit. Because of this automatic operation and simple, single switch starting, combined with lower-stressed components, life of the unit has been extended to a 1000 hr overhaul period, say the firm's engineers.

A speed trim system and advanced design fuel governor serves to maintain the unit at constant speed when the load is applied, with extremely fine control. The alternator frequency is said to be accurate to .002 per cent. It is considered by the company to be the most accurate speed control available on any gas turbine drive.

Offset Reducer

T. J. Cope, Inc., Collegeville, Pa., announces the offset reducer, a new fitting for its cable supporting system of prefabricated expanded metal trough.

The reducer is available with left hand and right hand bends and in any combinations of standard widths of 6, 9, 12, 18, and 24-in. A straight reducer is also available in the same combinations.

Expanded Metal Cable Trough is used in industry and utilities as a continuous support for power and control cables, the firm states. A unique feature of this system is said to be the pin-type coupler that greatly simplifies and speeds installation. A slotted aluminum plate overlaps the bottom of two connecting pieces of trough and two steel pins are driven into place through interlocking barrels on the sides, to provide rigid connections and eliminate the need for conventional nuts, bolts, and washers.

NATIONAL ACME

SNAP-LOCK

TRADE MARK

THE ORIGINAL SNAP ACTION LOCKING SWITCH

All National Acme Switches—Limit, Push Button, or Motor Starter Switches employ the same dependable, basic, SNAP-LOCK design. As illustrated above, the snap-action locking mechanism is simple, fool-proof and long-lived. Self-wiping, coin-silver contacts insure quick action make and break—with maximum wear resistance. For AC or DC service.

Electrical and mechanical sides are separated by a wall within a sturdy die-cast housing which is fully insulated, and is oil and dust resistant. Can be furnished water and oil-tight.

Limit Switches

Made in both single-pole and double-pole series, and with a wide variety of standard operating levers. Also made in push-lever type and with explosion-resistant housing.

Push Button

Made in heavy-duty, flush or surface-mounted types.

Motor Starter

Designed for 3-phase motors to 7½ HP on AC; ½ HP on DC.

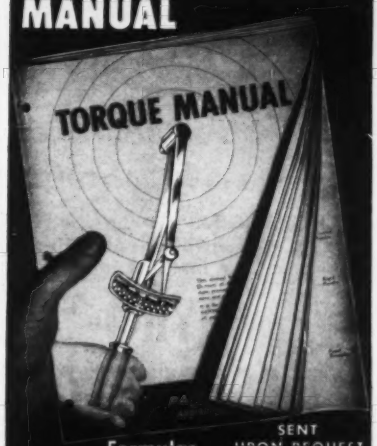
FOR COMPLETE DETAILS send for Bulletin EM-51

Electrical Manufacturing Division

National Acme

THE NATIONAL ACME COMPANY
192 East 131st Street, Cleveland 8, Ohio

"TORQUE WRENCH" MANUAL



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Formulas
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Screw Torque Data
Adapter Problems
General Principles

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ADDISON QUALITY ILLINOIS

Manufacturers of over 85% of the torque wrenches used in industry

...before it TALKS

...is the way our doctors put it—"Our chances of curing cancer are so much better when we have an opportunity to detect it *before it talks.*"

That's why we urge you to have periodic health check-ups that *always* include a thorough examination of the skin, mouth, lungs and rectum and, in women, the breasts and generative tract. Very often doctors can detect cancer in these areas long before the patient has noticed any symptoms.

For more life-saving facts phone the American Cancer Society office nearest you, or write to "Cancer"—in care of your local Post Office.

American Cancer Society

KEEP INFORMED

NEW EQUIPMENT
BUSINESS NOTES
LATEST CATALOGS

Hose Selector

A rubber covered hydraulic hose selector is being offered free to users of hydraulic control hose by Republic Rubber Div., Lee Rubber & Tire Corp., Youngstown 1, Ohio.

The revised selector contains latest SAE and industry specifications on hydraulic hose. Starting with any known factor, such as ID, OD, minimum burst, working pressure required or bend radius, a designer or maintenance man can use the selector to determine the proper Wiretex rubber covered hydraulic control hose for his needs, the company states.

Cooling System

A new system of cooling large power transformers has been announced by Allis-Chalmers Mfg. Co., Milwaukee 1, Wis. It makes use of the flexibility possible when two or more large transformers are connected to a common forced oil manifold cooling system.

With the new system, the company says, one transformer can carry a major portion of the load of two units indefinitely with no increase in temperature. First installations for the system will be in generating stations using cross compound turbines.

The transformers can be placed in almost any physical relationship to each other to take advantage of the most economical bus or overhead connections. One or more pairs of cooling manifolds run from one transformer to the other. These manifolds may be mounted between or alongside the transformers.

On the manifolds are mounted groups of Electro-Coolers (forced oil/forced air heat exchanger units) similar to those used on large power transformers.

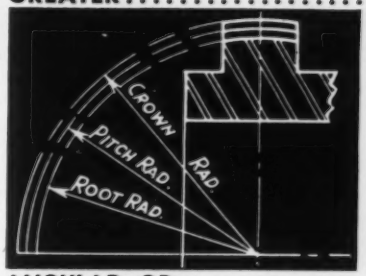
In normal operation, closed valves are located between the cooler banks. An integral part of the system are controls for the valves and cooling fan motors.

These can be automatic and interlocked with primary and secondary electrical switching where desired.

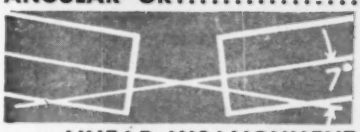
The firm says that to take full advantage of the overload carrying capacity of such a system, the copper to iron design ratio of the transformer is modified slightly. Since capacity of a transformer is limited by the cooling system's ability to carry heat away from the hottest point in the transformer, there is no theoretical limit to the emergency increase in capacity available from additional cooling. However, in installations designed to date, each transformer is designed to carry 175 per cent of full load continuously when both banks of Electro-Coolers are in service. Where less than 125 per cent capacity is required, it may not be necessary to operate all of the Electro-Cooler fans.

The company says the system solves two problems that have faced the utility industry. First, three-phase generating or transmission loads which require transformers that are too large to handle with existing shipping facilities can now be served with two or more

PERFECT SPHERICAL TOOTH FORMATION PERMITS GREATER.....



ANGULAR OR.....

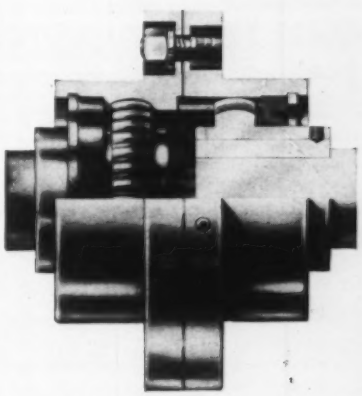


.....LINEAR MISALIGNMENT

The Philadelphia SPHEREFLEX COUPLING features a Spherical cut tooth which allows a ball and socket action between mating teeth up to 14° angular misalignment—and due to this angular capacity, a much greater amount of parallel misalignment is possible, which varies directly as the pitch diameter of the gears. All this is accomplished by gearing having a minimum back-lash.

By using Sphereflex Couplings, you can eliminate excessive bearing loads and cyclical bending stresses, which are caused by misalignment between shafts.

Send for Catalog C-560, and be convinced.



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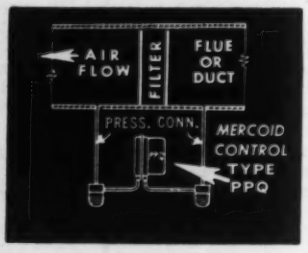
Has Hermetically Sealed Magnetic Mercury Switch

FOR AIR OR GAS (INCHES OR FRACTION OF INCHES OF WATER)

For low pressure or vacuum—to "make" or "break" electrical circuits on small changes in the difference between two pressures. Examples: to indicate a change in resistance through a filter (see illustration); to indicate a change in differential due to a change in air flow conditions; to indicate interruption of air flow.

This control incorporates two pressure chambers separated by a sensitive diaphragm. Each chamber is connected to a separate pressure source and the control is set to operate as the relationship of the two pressures change.



OPERATING RANGES—6" vacuum to 6" pressure (sensitivity .03") and 30" vacuum to 30" pressure (sensitivity .1" to .2").

CIRCUIT ARRANGEMENTS—several models available to accomplish the following operations:

SPST—USING ONE MAGNETIC SWITCH—open or close switch contact either on an increase or decrease at pressure difference.

SPST—USING TWO MAGNETIC SWITCHES FOR TWO STAGE OPERATION. Open/close both switch contacts on an increase in pressure difference.

Open one contact on increasing pressure difference and one on decreasing pressure difference.

Close one contact on increasing pressure difference and one on decreasing pressure difference.

CASE STYLES—three types to meet following conditions: Indoor (general purpose), Outdoor (weather resistant), and Hazardous locations (explosion-proof).

WRITE FOR BULLETIN No. 14N

THE MERCOID CORPORATION
4211 Belmont Ave., Chicago 41, Ill.

KEEP INFORMED — NEW EQUIPMENT · BUSINESS NOTES · LATEST CATALOGS

units of practical size. Second, the necessity of relying on one three-phase transformer to handle large blocks of generated power is eliminated. The door is now open to 1,000,000-kw generating units, the company states. Essentially, the new system provides single-phase reliability with three-phase economy.

Cost of the system is somewhat greater than that of one large unit (where such a unit can be built and shipped), but only slightly greater than two half-size units without the added versatility and overload carrying ability of the new system. While the greatest demand is expected to be for systems using two identical transformers, it will be entirely practical to use common cooling for three or more units, either single or three phase. Water cooling can also be utilized in place of forced air.

Centrifugal Compressors

Kathabar Div., Surface Combustion Corp., Toledo, Ohio, is producing a line of centrifugal compressors ranging from 200 to 2000 tons for use in comfort and industrial process air conditioning.

The units are of the overhung type with two stages, balanced back-to-back impellers and diffusers. According to the company, automatically controlled adjustable inlet guide vanes provide optimum stability and efficiency at all loads, 20 to 100 per cent.

The use of the guide vanes, said by the company to be a notable first in the large centrifugal air conditioning field, permits constant speed operation with a squirrel-cage induction or synchronous motor with lower power input through the control.

Mixer-Unloader

A unit for removing and treating ash and other dry materials is available from Allen-Sherman-Hoff Co., 259 E. Lancaster Ave., Wynnewood, Pa. Known as the Type B continuous mixer and unloader, the unit continuously mixes material with water and discharges the properly moistened mixture into waiting trucks or rail cars.

Featuring control from ground level rather than from a raised platform, the unit is suspended from the base of a storage bin. The company says this permits the operator to watch the discharge and regulate conveniently located water and feed controls to insure the right material-water consistency. A single large-orifice water nozzle provides increased moistening efficiency and is less likely to plug from water sediment. The entry and discharge is from the same position on the mixer.

Being shorter in over-all height and suspended from the base of the storage bin, the unit gives a saving in column heights and eliminates floor supports, the firm states. The unit is self-contained and may be lowered by a hoist for maintenance and overhaul at ground level. A rotary feeder is used to control flow of fine grain material to the unit. An adjustable feed control baffle is used for

ENGINEERS

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Engineers who have a personal interest in precision mechanisms, where a high degree of accuracy is required . . . men with pride in the precision of the product they help build.

You will constantly be doing development work and testing in one of the most versatile Laboratories in the country...working with the top men in the field and with the finest test, research and development facilities. We are in the process of a Major, Permanent, Expansion Program. New plant facilities being added in suburban Milwaukee area.

To aid you in your professional advancement AC will provide financial assistance toward your Master's degree. A Graduate Program is available evenings at the University of Wisconsin, Milwaukee.

GM's Electronics Division aggressive position in the field of manufacture and GM's long-standing policy of decentralization creates individual opportunity and recognition for each Engineer hired.

Recent EE,ME Graduate Inquiries Also Invited

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Milwaukee offers ideal family living in a progressive neighborly community in cool, southern Wisconsin where swimming, boating, big league baseball and every shopping and cultural advantage is yours for the taking.

To arrange personal, confidential interview in your locality send full facts about yourself today to

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PERFORMANCE
Makes Gears
EASIER TO SELL

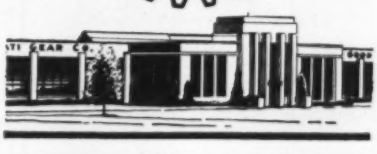
REPRESENTATIVE, THE CINCINNATI GEAR CO.

Often when calling on a new customer after his first gear order has been assembled and is in test operation, he will tell me something like "finest gears we ever used — certainly improved operating qualities of our product — no trouble in assembly, no vibration, they are as quiet as a precision watch". This customer is just learning what Cincinnati Gear's older customers already know, and what I've known for the thirteen years I've represented Cincinnati Gear in the Cleveland area: that we make *ONLY GOOD GEARS* — gears that give 100% performance at all times. If, by chance, there is an error, there is never a compromise; the gear is promptly replaced.

This pleases our customers, of course, but it also pleases me — and gives me the confidence in our firm and our product that I need to do a first-rate selling job. This confidence, I feel, is about the most valuable "sales aid" I have. I can solicit an order and know full well that the gears shipped will deliver performance desired — and result in the kind of customer satisfaction that leads to repeat orders. I can't think of anything that makes my job easier.

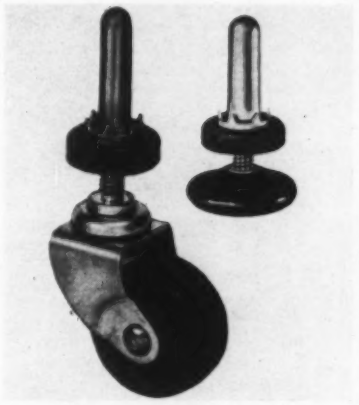
THE CINCINNATI GEAR CO.
CINCINNATI 27, OHIO
"Gears—Good Gears Only"

CINTI



KEEP INFORMED — NEW EQUIPMENT · BUSINESS NOTES · LATEST CATALOGS

dry mixtures of larger size material. In operation, dry material enters the unit through the rotary feeder. A screw-conveyor carries it to the high end of the mixing drum. A single jet of water impinges on a splash plate near the high end of the drum and wets the dry material as it enters the drum. As the wetted material travels toward the discharge end, it is mixed by the combined action of the rotating drum and a stationary scraper. Baffles check the forward movement of the mix through the drum for more thorough mixing.

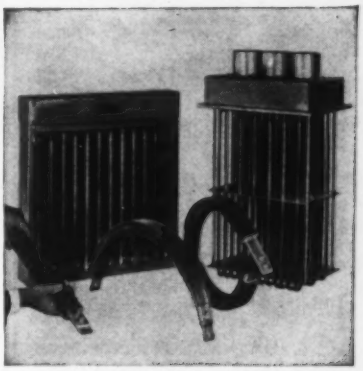


Adjustable Caster

Adjustable Caster Co., 1411 Walnut St., Philadelphia 2, Pa., announces a new double ball bearing adjustable caster and glide combination to provide fast on-the-spot finger adjustment, designed for leveling, stabilizing and protecting equipment or furniture when used on uneven floors. The unit incorporates a self-locking adjustment which permits a portable piece to be moved across the floor without the adjustment changing. The design of the caster is such that the $1^{5}/_{8}$-in. diameter phenolic, plastic wheel can swivel, yet the height adjustment remains self-locking at all times.

The firm says that if a piece, such as a typewriter stand, desk or table is moved to a new location for use where uneven floor conditions are encountered, or legs are partly on or off rugs, instant finger adjustment is available. No wrenches or locknuts are required to lock the adjustment. This feature is obtained through the use of a spline threaded stem which cannot turn, but is raised or lowered and keyed in the serrated hole in the socket. A captive adjusting nut in the socket does the raising and lowering when turned with the fingers.

Another feature of the design is a choice or alternate use of a plastic base adjustable glide in place of the wheel type. Phenolic glides are available in $1^{1}/_{4}$, $1^{1}/_{2}$, and 2 in. diameter sizes. The socket part is standard for use with either caster or glide. Sockets are available with welding projections for metal installations, or with screw holes for installation in wooden legs.



accurately controlled temperatures to 1000°F easily maintained

CHROMALOX
Electric
AIR DUCT HEATERS

are the modern, economical answer to your requirements for heating air and gases under forced circulation. Parallel fin design dissipates maximum heat with minimum turbulence of air stream.

Easily installed in round or rectangular ducts. Either manual or automatic thermostat control. Moisture proof types available.

Used in ducts for drying, curing, baking and annealing ovens—there's a heater for any air flow or temperature rise.

Let your Chromalox Sales-Engineering staff solve your heating problems . . . electrically

Write for your copy of Catalog 50

—for full information on the complete line of Chromalox Electric Heaters and controls.

For ideas on additional applications of electric heat, request Booklet F1550—"101 Ways to Apply Electric Heat."

Edwin L. Wiegand Company
7646 Thomas Boulevard, Pittsburgh 8, Pennsylvania

EDWIN L. WIEGAND COMPANY
7646 Thomas Boulevard, Pittsburgh 8, Pa.
I would like to have . . .
☐ a copy of Catalog 50
☐ a copy of "101 Ways"
☐ a Sales Engineer contact me.

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Company_____
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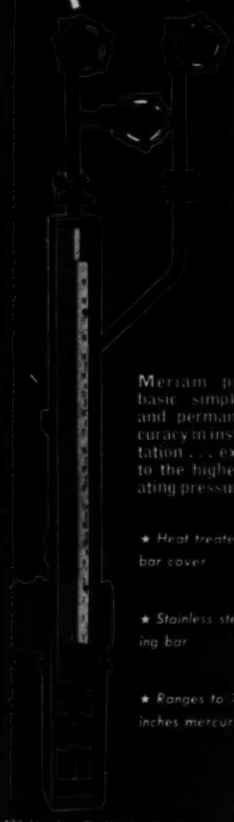
City_____ Zone____ State____

A-4468A

UNMATCHED ACCURACY

at highest working pressures

At pressures up to 2000 psi, this Meriam Manometer provides critically accurate flow or differential pressure measurement. Constructed of solid bar stock steel, all parts are precision fitted, hand lapped. Each unit is cold hydraulic tested to 5000 psi.



Meriam provides basic simplicity . . . and permanent accuracy in instrumentation . . . extending to the highest operating pressures.

★ Heat treated glass bar cover

★ Stainless steel backing bar

★ Ranges to 70 inches mercury

Write for Bulletin C-12.

Meriam Manometer Instrumentation
. . . for pressures, vacuums, flows, liquid levels.

meriam

INSTRUMENT COMPANY
10920 Madison Ave. • Cleveland 2, Ohio

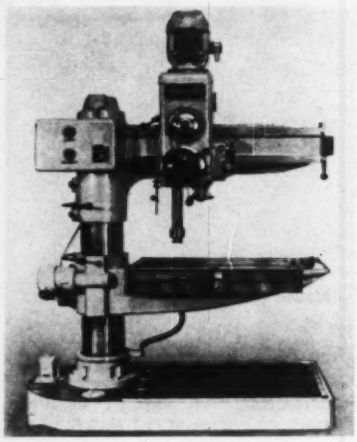
KEEP INFORMED — NEW EQUIPMENT, BUSINESS NOTES, LATEST CATALOGS

Induction Potentiometer

A new size 11 induction potentiometer with a linearity of ± 0.1 per cent over a range from 0 to 75 deg is announced by Diehl Mfg. Co., Somerville, N. J.

The firm says an important feature of the unit is the placement of the input windings on the stator. This relieves the brushes and collector rings from the necessity of carrying current. In addition, the unit is completely machine wound. The unit operates at 70,000-ft altitude without pressurization.

Key specifications include: input impedances of up to 750 ohms; phase shift of ± five min with rotor position; maximum null voltage of one mv per v of input; weight of 4.7 oz.



Radial Drill

A new 3 ft 12 in. master radial drill, introduced by S & S Machinery Co., 140 53rd St., Brooklyn, N. Y., is designed and built to make it capable of sensitive boring and reaming as well as drilling—very often without the use of pilots.

In place of the conventional-type arm that moves up and down the column, the new Drill has a fixed arm which always remains at the same height and can be swung 360 deg. To position the workpiece, the machine has a motorized table that moves vertically on the column, placing the workpiece at the appropriate height for the job.

The table, also capable of swinging 360 deg, can be moved completely out of the way when the base is to be used for fixturine large workpieces. Raising and lowering of the table is by hand or push-button power. Overriding is prevented by two stops with electrical safety interlock. Both the fixed arm and the movable table have locking devices that clamp the swinging mechanism in place during the machining operation.

The fixed arm design, combined with a Nitrided spindle, fully supported for its full

ENGINEERS

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Milwaukee 2, Wis.

Seeks Engineers with experience in

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- Mechanical Design
- Electronics Package Design
- Electronics Package Cooling

Enjoy Challenging Opportunities in the most versatile Laboratories in the country. Work with the top men in the field and with the finest test, research and development facilities. We are in the process of a Major, Permanent, Expansion Program. New Plant facilities being added in suburban Milwaukee area.

To aid you in your professional advancement AC will provide financial assistance toward your Master's degree. A Graduate Program is available evenings at the University of Wisconsin, Milwaukee.

GM's Electronics Division aggressive position in the field of manufacture and GM's long-standing policy of decentralization creates individual opportunity and recognition for each Engineer hired.

Recent EE,ME Graduate Inquiries Also Invited

Milwaukee offers ideal family living in a progressive neighborly community in cool, southern Wisconsin where swimming, boating, big league baseball and every shopping and cultural advantage is yours for the taking.

To arrange personal, confidential interview in your locality send full facts about yourself today to

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AC Electronics Div.
General Motors Corp.
Milwaukee 2, Wis.

KEEP INFORMED

NEW EQUIPMENT
BUSINESS NOTES
LATEST CATALOGS

stroke, makes the machine highly suitable for precision boring, the company says. Both a hand wheel and fine hand wheel are available for advancing the spindle. A one-piece 12 in. column, said to be over-large for this size radial, contributes to the precision of the machine's operation.

Twelve spindle speeds, ranging from 60 to 2100 rpm, can be obtained through the pre-selector, with reverse speeds obtained instantly. Four spindle feeds can be selected by means of a feed and speed calculator located on the center of the head. A graduated depth control dial for use during hand or power operation prevents overdrilling.

BUSINESS NOTES

Companies Merge

Announcement has been made of the merger of Thermistor Corp. of America and Vibro-Ceramics Corp. with Gulton Mfg. Corp. which has changed its name to Gulton Industries, Inc.

Thermistor and Vibro-Ceramics will operate as divisions of the new organization, as will Engineered Magnetics, Culver City, Calif., which is presently a division of Gulton Mfg. Corp. General offices and main operating plant of the corporation are in Metuchen, N. J.

Opens Pensacola Office

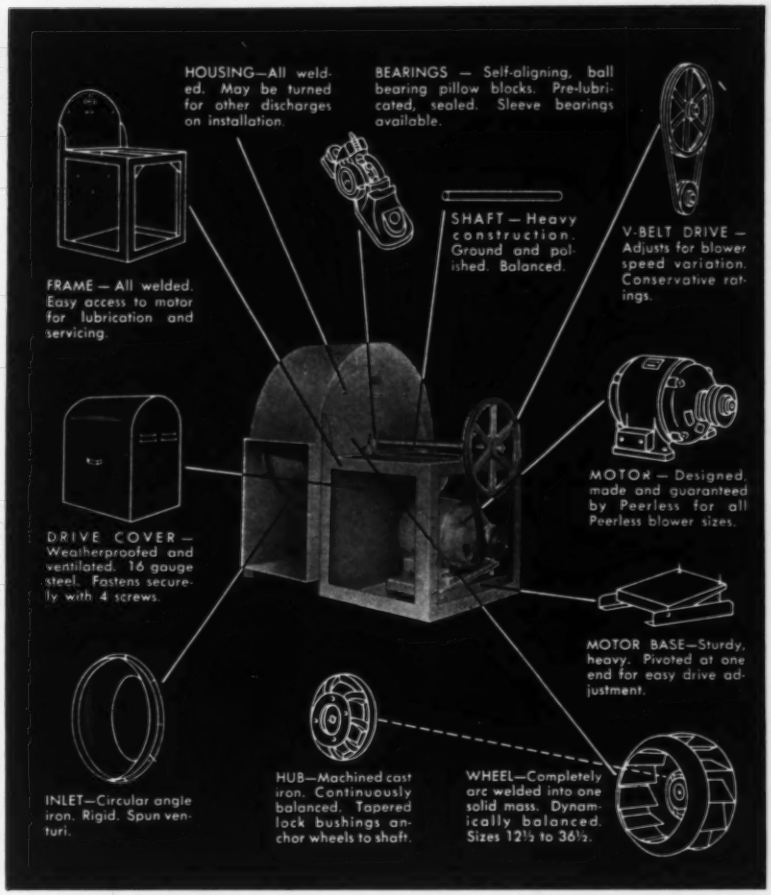
Fischer & Porter Co. announces the opening of a sales office in Pensacola, Florida. The new office will cover sales territory along the Gulf Coast of portions of Florida, Alabama and Mississippi, formerly handled out of New Orleans. Address of the new office is 603 Rue Max St., and the telephone number is Hemlock 3-2916.

Opens Chicago Office

A Chicago factory branch office has been opened at 5627 S. Harlem Ave., Chicago 38, Ill., by the Baker-Raulang Co., manufacturer of gas and electric materials handling trucks. The new branch will have complete stocks of parts, and facilities to demonstrate and service Baker-Raulang's line of gasoline, LPG, and battery-powered fork lift trucks, crane trucks, platform trucks, the Shoveloader front-end loader, and the unique Trave-loader side-loading fork truck.

Use a CLASSIFIED ADVERTISEMENT

for Quick Results


HOUSING—All welded. May be turned for other discharges on installation.
BEARINGS — Self-aligning, ball bearing pillow blocks. Pre-lubricated, sealed. Sleeve bearings available.
SHAFT — Heavy construction. Ground and polished. Balanced.
V-BELT DRIVE — Adjusts for blower speed variation. Conservative ratings.
FRAME — All welded. Easy access to motor for lubrication and servicing.
MOTOR — Designed, made and guaranteed by Peerless for all Peerless blower sizes.
DRIVE COVER — Weatherproofed and ventilated. 16 gauge steel. Fastens securely with 4 screws.
MOTOR BASE—Sturdy, heavy. Pivoted at one end for easy drive adjustment.
INLET—Circular angle iron. Rigid. Spun venturi.
HUB—Machined cast iron. Continuously balanced. Tapered lock bushings anchor wheels to shaft.
WHEEL—Completely arc welded into one solid mass. Dynamically balanced. Sizes 12½ to 36½.

Specially Engineered, Compatible Blower Components . . . The Reason for Outstanding Peerless Performance and Quality!

• This is the Peerless Backward Curve Blower, one of the workhorses of the dependable Peerless line. Like all Peerless units, it's designed, engineered and manufactured completely at Peerless . . . motor and all. It is this complete control from components to finished unit which enables us to unconditionally guarantee every fan and blower we make. Each component works in perfect harmony with the other to give quiet, trouble-free performance.

Peerless Backward Curve Blowers can be specified with confidence. They are thoroughly tested according to test codes. They meet PFMA, NAFM and NEMA standards. Scores of them are operating in schools, hospitals, other buildings and government installations all over the nation. We are used to producing to customer or government specifications.

Write, Wire or Phone Us Today!
Ask for Bulletins SDA-160 or SDA-200

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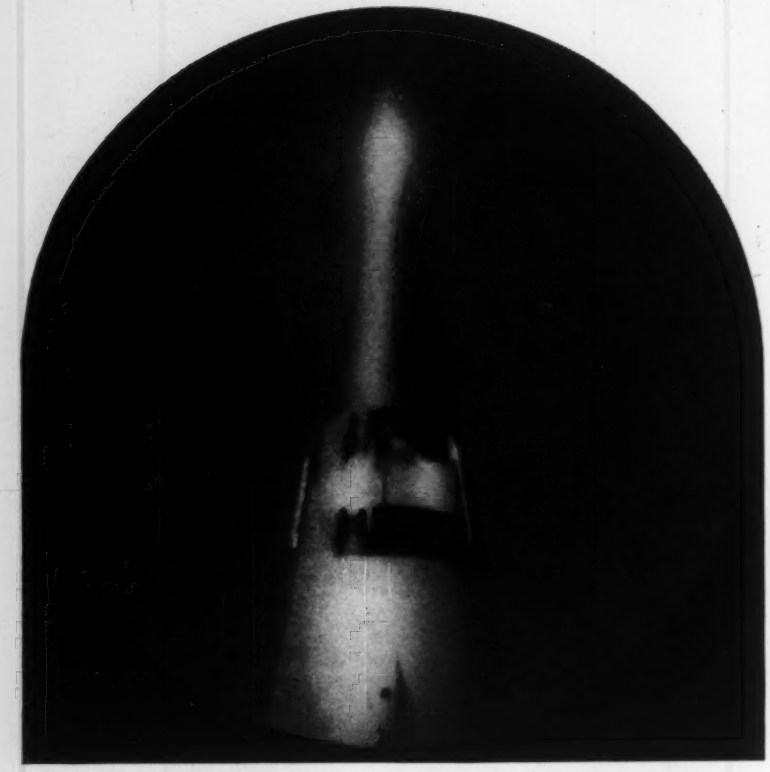


HOT TIP

(For Electronicists)

The big count-down has begun! In a matter of months, the tip of a Martin rocket will travel through space at a speed of 5 miles per second—and moments later the first man-made satellite will reach its orbit.

This event, the first of a series of 12 in the Martin-Navy VANGUARD program, will commence a new chapter in the short but exciting story of electronics.

Today, no other engineering organization in the world is more concerned with the outer-space electronics problems of tomorrow.

If you are interested, contact J. M. Hollyday, Dept. ME-09, The Martin Company, Baltimore, Maryland.

MARTIN

KEEP INFORMED — NEW EQUIPMENT · BUSINESS NOTES · LATEST CATALOGS

Relocates Offices

The Chicago sales offices for two divisions of The M. W. Kellogg Co.—the Chemical Manufacturing Div., and the Chimney Div.,—are now located at 221 North LaSalle St. They were previously at 79 East Adams. The new telephone number in Chicago is Central 6-2871. Kellogg is a subsidiary of Pullman Inc.

Opens Ferrite Center

Airtron, Inc. has opened a new division at 317 Vassar St., Cambridge, Mass.

Known as the Cambridge Div. Airtron, Inc., the new ferrite center includes complete research, design, development and production facilities. The Airtron Ferrite Materials Laboratory, formerly located at the main plant buildings in Linden, N. J., has been transferred to Cambridge where it has been expanded.

Dealer Appointed

Charles Bruning Company, Inc., has been appointed a nationwide dealer for Verifax copying machines and materials by the Eastman Kodak Co., Rochester, N. Y. The company's 25 branches in the United States will stock, sell, and service the copiers.

Expands Operations

The Cleveland office of Robertshaw-Fulton Controls Co. has moved into new, larger quarters at 6116 St. Clair Ave. The company's Cleveland district serves manufacturers of ranges and other cooking appliances in a territory that includes northern Ohio, western Pennsylvania, western New York, and West Virgina; and manufacturers of heating appliances in Ohio, Kentucky, West Virginia, western Pennsylvania and western New York.

Plant Addition Completed

A 20,000-sq ft plant addition has been completed by Surface Combustion Corp., 2375 Dorr St., Toledo, Ohio.

Facilities for the structure include railroad and truck loading and a 15-ton overhead crane. The plant addition houses the Heat Treat Furnace and Gas Generator Assembly Dept.

Opens New Plant

Mammoth Furnace Company, formerly of 509 Vandalia St., St. Paul, Minn. announces the opening of a new, enlarged plant and home office at 6425 Cambridge St., Minneapolis 16, Minn.

The company manufactures both the Compacto and Adapto models of Mammoth Furnace as well as Commercial-Aire Direct-Fired Heaters. All lines are distributed nationally.

For Consulting Engineers Turn to Page 194

KEEP INFORMED

NEW EQUIPMENT
BUSINESS NOTES
LATEST CATALOGS

Steel Plant Opens

Completion and opening of its new iron and steel plant, part of a multimillion dollar program of consolidation and expansion of all manufacturing operations at its Fairmount site, has been announced by the Lunkenheimer Co., Cincinnati, Ohio.

The two-story structure houses modern precision equipment for the manufacture of iron and steel valves. The plant adds more than 100,000 square feet of floor space to Lunkenheimer's Fairmount production facilities. The new plant is adjacent to Lunkenheimer's bronze plant, which was completely modernized recently at a cost of $3 million as part of the overall program.

LATEST CATALOGS

Controlling Instrumentation

"A new approach" to recording, indicating and controlling instruments required in industrial processing, is described in a four-page bulletin published by Fielden Instrument Div. Robertshaw-Fulton Controls Co., 2920 N. Fourth St., Philadelphia 33, Pa.

The new bulletin, No. F-403, describes instrument systems of simplicity and flexibility which feature four basic components that can be interchanged to perform a variety of functions.

Bearing Grease

A stable, high-melt-point grease for bearings running at temperatures up to 250 F, or for sealed antifriction bearings used at normal temperatures is described in Bulletin 47, "Sun N-52X Grease," available from Sun Oil Co., Philadelphia 3, Pa.

Included is a chart showing the number of months or years this grease may be expected to lubricate at a given operating temperature.

Cupola Dust Control

A product bulletin prepared specifically for the solution of foundry cupola dust has been released by American Air Filter Co., Inc., 215 Central Ave., Louisville 8, Ky. Bulletin No. 292 describes the operation of the firm's new Amerclone, designed to handle large exhaust volumes of granular dust such as those found in cupolas or boiler stacks. The bulletin explains how counterweighted caps are added to the cupola tops and cupola stack gases are pulled through damper section where initial flash cooling occurs. In the cooling tower regulated cooling continues with exit temperatures constant, even during the high stack gas temperatures of melt-down. Cinders, dust and some metallic fumes are then removed by the unit before hot, relatively dry gases are discharged from induced draft fan through the discharge stack.

NUGENT
LUBRICATING SPECIALTIES
LET YOU
SEE
WHAT'S
GOING
ON!

- **SIGHT FEED VALVES** provide a means of regulating and visually checking oil flow at the point of delivery to bearings, gears, etc.
- **SIGHT FLOW INDICATORS** tell you at a glance, or by the sound of an alarm bell, whether or not oil is flowing properly to vital parts.
- **MULTIPLE OILERS** are furnished in a variety of types with any number of feeds and will materially reduce lubrication costs for machinery with many enclosed or hard-to-get-at bearings.

Nugent manufactures a complete line of lubricating specialties. Write for descriptive literature mentioning the type of equipment you are interested in.

NUGENT TRADE MARK

Wm. W. Nugent & Co., Inc.
3412 Cleveland St. Skokie, Illinois

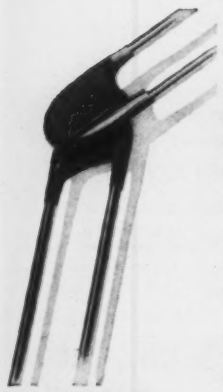
Established 1897

OIL FILTERS, OILING AND FILTERING SYSTEMS, TELESCOPIC OILERS, OILING DEVICES, SIGHT FEED VALVES, FLOW INDICATORS
Representatives in Boston • Cincinnati • Detroit • Houston • La Junta, Colo. • Los Angeles Minneapolis • New Orleans • New York • Philadelphia • Portland, Ore. • San Francisco Seattle • St. Louis • Tulsa • Representatives in Canada: Montreal • Toronto • Vancouver

Check the response-to-the-touch. You can actually feel the difference!

That's why the Paragon Drafting Machine noticeably cuts end-of-the-day fatigue . . . saves costly man hours . . . helps raise working standards.

See how easily protractor control ring can be reached—no matter what position your hand is in. Another time saver. Touch that ring with your *little* finger and scales rotate freely. Release pressure and scales automatically lock to nearest 15° position. And intermediate angles are just as easily set!



Top day-to-day performance is guaranteed by unique "open center" design of arms which protects smooth-working factory-set band tension.

A good look at a Paragon and a touch on that control ring is worth 1,000 words! Try it before you buy *any* drafting machine—you can *feel* the difference.

89 YEARS OF LEADERSHIP

In equipment and materials for drafting, surveying, reproduction and optical tooling . . . in slide rules and measuring tapes.

K+E **KEUFFEL & ESSER CO.**

NEW YORK • HOBOKEN, N. J. • Detroit • Chicago • St. Louis • Dallas • San Francisco • Los Angeles • Seattle • Montreal

KEEP INFORMED — NEW EQUIPMENT, BUSINESS NOTES, LATEST CATALOGS

Tool Room Grinding

"A Handbook on Tool Room Grinding" is the title of a new 222-page booklet published by Norton Co., Worcester 6, Mass.

This booklet combines information previously found in three booklets covering general tool grinding, carbide tools and cast alloy tools. Ask for Form 781.

Cooling Controls

A bulletin describing self-powered cooling controls for compressors, stills, solvent coolers degreasers, oil coolers, small engines, condensers, is available from Sarco Co., Inc., Dept. P, Empire State Bldg., New York 1, N. Y. Write for Bulletin 710B.

Conveyor Safety

Jervis B. Webb Co., 8951 Alpine Ave., Detroit 4, Mich., has published a four-page folder on "Ten Rules for Safety in Conveyor Operation."

The report deals primarily with safety rules that should be followed when installing a conveyor. Several different types of conveyors are covered in the report such as overhead conveyors, belt conveyors, slat conveyors, bucket elevators.

Expansion Roof Tanks

Graver Tank & Mfg. Co., Inc., East Chicago, Ind., has available a four-page bulletin containing application photos and data on its expansion roof tank systems designed to hold terminal losses to a minimum.

Figures on average annual temperatures compared to percentage terminal losses are included for each of the 14 units shown.

Wire Rope Slings

Registered cable-laid slings, said to offer flexibility of hemp, strength of steel, kink-free construction and a bright Galacco finish, are featured in a new four-page folder, DH-532A, issued by the Wire Rope Sling Dept., American Chain & Cable Co., Inc., Wilkes-Barre, Pa.

The line offers a variety of sizes and styles in vertical, basket, bridle or choker hitch.

Use a
CLASSIFIED
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for Quick Results

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NEW EQUIPMENT
BUSINESS NOTES
LATEST CATALOGS

Cottonseed Weighing

High-speed, near-continuous operation of an automatic cottonseed scale in cotton gin operation is described and illustrated in a four-page technical reference, No. 56B, offered by Richardson Scale Co., Van Houten Ave., Clifton, N. J.

The reference describes several advantages of the scale, including high-speed weighing that maintains rates parallel to ginning; how the scale eliminates stoppage problems; and how it reduces headroom requirements. Feeding, weighing and discharge operations are discussed and illustrated in three drawings. Seven photographs show the scale's belt feeder, weigh hopper and main beam system, control system and automatic printing dial head, housing, two counter mechanisms and a typical installation of the scale.

Grinding Wheels

A color-illustrated bulletin, GP-56 on precision grinding wheels has been prepared by Electro Refractories & Abrasives Corp., 344 Delaware Ave., Buffalo 2, N. Y.

The booklet covers new developments in wheels for centerless, surface, internal and cylindrical grinding.

High Capacity Flowmeter

Fischer & Porter Co., 749 Jacksonville Rd., Hatboro, Pa., has published a catalog, 10-A-43, describing the company's line of high capacity variable-area flowmeters.

These meters are specially designed for those high capacity services where the advantages of linear flow output, wide range, and freedom from piping limitations are required. Maximum flow rates of 60 gpm to greater than 4000 gpm can be handled in meters with 2- to 12-in. connections.

Furnace Accessories

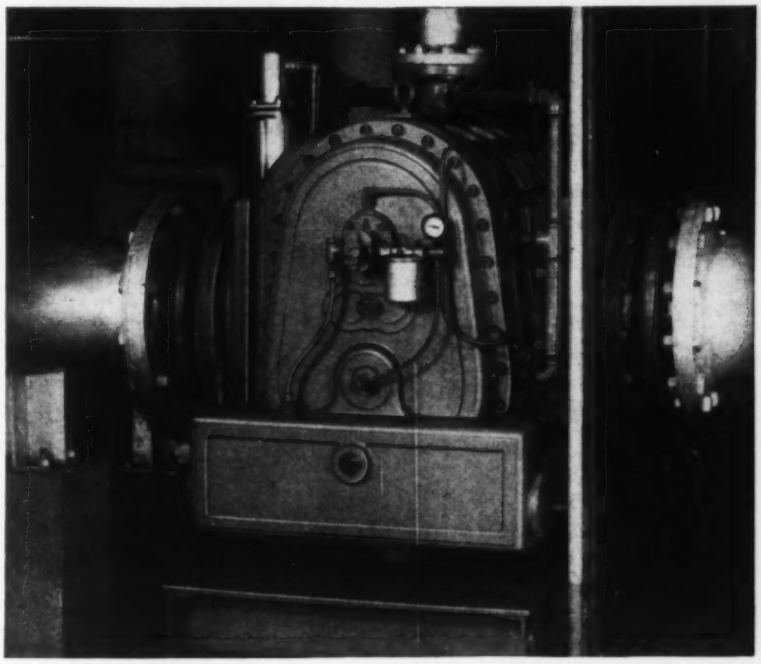
An eight-page two-color catalog No. 601, which describes auxiliary items commonly used in conjunction with melting furnaces in the foundry has been issued by Lindberg-Fisher Div., Lindberg Engineering Co., 2450 W. Hubbard St., Chicago 12, Ill.

Replacement linings, high temperature cements, silicon-carbide base blocks, oil burners, blowers, cast iron pots, and oil or gas fired bell ladle heaters are listed. Charts covering dimensions, burner and blower ratings and burner cross-section diagrams are provided.

Quarter-Turn Fasteners

Quarter-turn fasteners designed for quick, positive locking of removable sections are the subject of a 12-page, two-color catalog released by Southco Div., South Chester Corp., 200 Industrial Highway, Lester, Pa.

The illustrated catalog describes in detail three main types of fasteners–No. 5, No. 2, and Type H—and their applications for general, light, or heavy duty, including their use on aircraft. It includes information on specifications, head styles, installation procedures, strength characteristics.



4 years of gruelling operation frequently at overload pressures and still no maintenance needed

Since 1951, Standardaire Blowers installed at Spencer Chemical Company have been operating 24 hours a day supplying process air for production of synthetic ammonia.

Although normally operated at 1750 rpm and 8 psig, these units periodically are required to run at more than 50 percent above rated capacity for as long as a month at a time. When brick and catalyst dust seal over reformer catalyst beds, this pressure is needed to force the gases through and avoid costly shutdowns.

After four years of this gruelling, continuous operation, a recent test disclosed virtually no reduction in efficiency of the Standardaire Blowers. They have required no maintenance.

Exclusive cycloidal design and simple, compact construction enable Standardaire Blowers to move more gas or air per pound of blower, with less wear, less maintenance and power consumption. Write for complete information.

READ STANDARD
CORPORATION

BLOWER-STOKER DIVISION
370 LEXINGTON AVENUE, NEW YORK 17, NEW YORK

KEEP INFORMED

NEW EQUIPMENT
BUSINESS NOTES
LATEST CATALOGS

Pulse Control Systems

A technical bulletin, No. 136, published by Electronic Instruments Div., Burroughs Corp., 1209 Vine St., Philadelphia 7, Pa., gives information on how both manufacturers and users of tape-wound or ferrite cores can benefit from using pulse control systems to test cores by digital techniques.

Entitled "Pulse Patterns for Testing Cores," the 16-page booklet discusses the current state of the magnetic core manufacturing art. The booklet discusses reliable testing procedures are a must, points out the need for equipment which not only tests how a core will meet specifications within all necessary ranges of tolerance, but also how it will eventually operate in the system for which it is intended.

Air, Oil Couplers

A 16-page catalog containing facts and figures on automatic, semi-automatic and regular quick detachable couplers for air, oil, and grease lines has just been made available by the Foster Mfg. Co., Inc., 2850 Gravios, St. Louis 18, Mo., Dept. 47.

The booklet, which also contains information on the company's line of chrome sleeves and air, oil and grease line fittings, shows practical applications of the fittings with various air operated tools.

DESIGNERS

WHAT major organization offers continual original work assignments?

For the answer, turn to page 183

Bulk Cement Handling

A four-page, two-color bulletin, FK-27, on bulk cement handling in New York Harbor is available from Fuller Co., Catasauqua, Pa.

Illustrating how cement may successfully be handled in bulk, the bulletin specifically describes a system of materials handling for the loading facilities of the Lehigh Valley Railroad Company's Jersey City, N. J., terminal. Information is offered on the Fuller-Kinyon pumping system which pumps cement aboard a barge. The bulletin points out the ease and speed with which the barge is loaded at the rate of 1000 bbl an hour from a car spotted on the dock. Further, the barge unloading procedure is described, showing how the unloader conveys cement to a customer's storage silo on shore at a rate of 115 to 150 barrels an hour.

Lubricator Service Instruction

Detailed service instructions and operating information on high capacity spring discharge piston pump lubricators are included in a two-color, two-page service instruction sheet offered by Bijur Lubricating Corp., Rochelle Park, N. J.

Designated type 'D,' the "One-Shot" lubricators are operated by pushing down the handle against the stroke adjustment cap and allowing the spring to slowly discharge a predetermined amount of oil into the distribution system. The lubricators are adaptable to machines requiring closely controlled but infrequent oil service. Able to service as many as 100 lubrication points, the systems are said to be useful on punch presses, textile machines and many types of special machines.

WORN Cylinders?

SCORED Cylinders?

PORUS - KROME

Good for the Life of your Engines

is the answer.

- **Reclaim the bores of worn or scored power cylinder liners with wear resistant PORUS-KROME.**
- **Write for detailed information on this economical service for power plants.**

Dept. K-1. VAN DER HORST CORP., OLEAN, N. Y.

OLEAN, NEW YORK — TERRELL, TEXAS

VAN DER HORST

HILVERSUM, HOLLAND — LOS ANGELES, CALIFORNIA*

*SparTan Engineering

Panel Instrument

A new bulletin, A-7-F, covering the styles and ranges of panel instruments in sizes from $2^1/_2$ to $4^3/_8$ in. is available from Weston Electrical Instrument Corp., a subsidiary of Daystrom, Inc., 614 Frelinghuysen Ave., Newark 5, N. J.

The bulletin contains specifications on all a-c and d-c instruments including rectifier type a-c and thermo instruments, power level meters, vu and db meters, frequency meters and wattmeters. Also included are dimensional diagrams, typical full size scales, and detail data on instruments for high frequency measurements.

Set Screw Developments

Catalog No. 21 issued by the Set Screw & Mfg. Co., Bartlett, Ill., is a 28-page specialized catalog of set screws listing and describing every type of standard set screw and many special types designed to meet special conditions of vibration, close precision setting resistance to tampering, chemicals or heat, need for increased holding power.

Among the special types developed by the company which are described in the new catalog are new hopper-fed set screws and the specially developed mechanisms to feed automatically both socket and slotted headless set screws.

KEEP INFORMED — NEW EQUIPMENT BUSINESS NOTES LATEST CATALOGS

Miniature Flexible Couplings

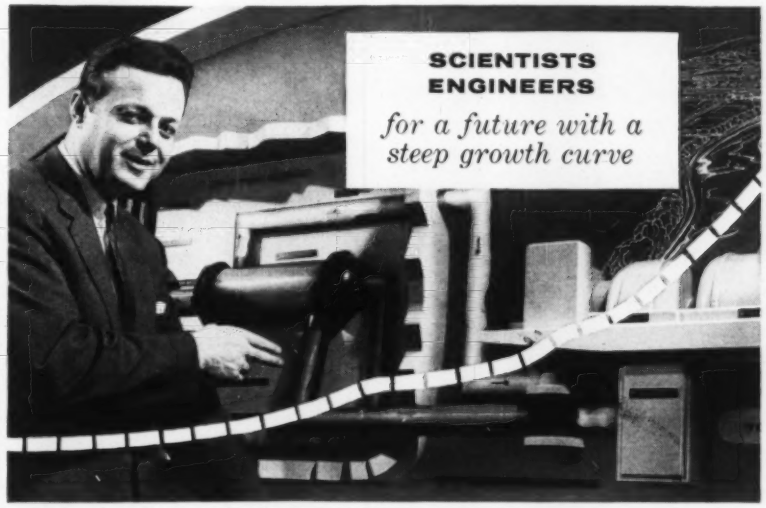
A new four-page bulletin describing standard and special miniature couplings for power transmission is available from Thomas Flexible Coupling Co., Warren, Pa.

The bulletin, called MC 100, pictures, describes and shows dimensional drawings of miniaturized couplings which can be used on servo-mechanisms, computers and other small devices. The couplings are designed for speeds up to 50,000 rpm and will compensate for parallel and angular misalignment while relieving bearing loads, holding constant torque and synchronism. They are said to be nonmagnetic, torsionally rigid, inertially low and light weight.

Load Center Transformer

A 12-page bulletin, CS-1000, containing engineering data, weights and dimensions on load center transformers is available from Kuhlman Electric Co., Bay City, Mich.

The bulletin covers construction features on liquid-filled and dry-type units for either indoor or outdoor installation with illustrations and drawings on typical applications. It also gives descriptions on standard accessories, ratings available, and the types of core and coil assemblies offered.



look to Westinghouse Commercial Atomic Power

CAPA—Commercial Atomic Power Activity—is the nucleus of the most dynamic new division at Westinghouse, the leader in Atomic Power. Our growth is bound to be *steep*—as electric power demand and atomic power production pyramid sharply.

We're "fluid"—not fixed. New supervisory jobs open up fast! We're entirely *commercial*—not dependent on government contracts. Opportunities for advanced study at company expense Get in on the "industry of tomorrow" *today* . . . at Westinghouse CAPA.

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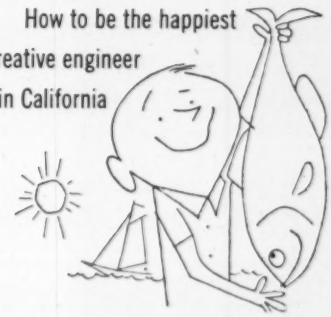
Please mail résumé of your professional and business background to: C. S. Southard, Westinghouse Commercial Atomic Power, Box 355, Dept. 126, Pittsburgh 30, Pennsylvania.

WATCH WESTINGHOUSE!
FIRST IN ATOMIC POWER

How to be the happiest creative engineer in California



Beckman Instruments, Inc.* offers E.E.'s, M.E.'s, Manufacturing, and Sales Engineers the kinds of jobs that creative men dream about. Top salary, all employment "extras" including our Educational Assistance Plan, modern facilities and personal recognition that comes naturally with our decentralized operation. Small town living...but near metropolitan areas in either Fullerton, Newport Beach, Richmond, or Palo Alto.

*We're pacing the commercial electronics field ($3,000,000 sales in 1949 to $29,000,000 sales in 1955) and we'll be disappointed if you don't grow with us.

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Write Beckman Instruments, Inc., 2999 W. 6th St., Los Angeles 5, Calif. Ask for Career File #559

structures

STRESS ENGINEERS · STRUCTURES ENGINEERS · WEIGHT ENGINEERS · LOADS ENGINEERS · DYNAMICS ENGINEERS · FLUTTER ENGINEERS · COMPUTER SPECIALISTS · MECHANICAL ENGINEERS · CIVIL ENGINEERS

Expansion within Northrop Aircraft's Structures Department is creating an urgent demand for qualified personnel in all phases of guided missile, piloted aircraft, and equipment development. Included among the most critical job openings are positions for:

Stress Department—Mechanical or Civil Engineers to design missile ground handling equipment. An opportunity for men without aircraft experience to take advantage of the aircraft pay scale.

Structures Research—Creative engineers for three vital phases of Structural Research and Development: Thermo-Structural Analysis, High Speed Computing Technique Development and Structural Materials Research.

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Dynamics—Experienced flutter engineers required for work on a variety of dynamics problems including flutter models, analytical work involving electronic computers, and methods development.

Loads—Exciting and diversified assignments in the fields of both piloted and pilotless aircraft are now available in Structural Loads Group for engineers of all experience levels.

Stress Department—Experienced Structural Engineers for positions on Long Range Interceptor Project and on advanced missile designs.

A wide diversification of assignments within each field of specialization awaits the men capable of filling the above assignments. Responsibilities will include work on many phases of missile and aircraft design, guidance systems and boundary layer research.

If you qualify for any of these challenging opportunities, we invite you to contact Manager of Engineering Industrial Relations, Northrop Aircraft, Inc., Hawthorne, California, or call ORegon 8-9111, Extension 1893.

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PIONEERS IN ALL WEATHER AND PILOTLESS FLIGHT

8-A-49-B

KEEP INFORMED — NEW EQUIPMENT · BUSINESS NOTES · LATEST CATALOGS

Chlorine Handling Equipment

Wallace & Tiernan Inc., 25 Main St., Belleville 9, N. J., has published literature describing equipment used by industry for handling liquid and gaseous chlorine.

The new literature illustrates and describes such chlorine handling equipment as: liquid chlorine evaporators, valves and fittings for chlorine liquid and gas supply lines, manual and pilot operated chlorine pressure reducing valves, and chlorine gas metering equipment.

Lightweight Conveyor

An eight-page folder, No. 954, on the uses and advantages of lightweight overhead conveyor units is available from Jervis B. Webb Co., Dept. NLP, 8951 Alpine Ave., Detroit 4, Mich. Literature illustrates and describes 10 typical industrial uses for the lightweight conveyor. Complete specifications are included.

Indicating Washer

A device that automatically controls tightening of bolted connections and permits accurate preloading to as high as 80 per cent of bolt yield strength is described in a 12-page catalog published by Standard Pressed Steel Co., Jenkintown, Pa.

The new preload indicating washer, called PLI-Washer, consists of two concentric steel rings sandwiched between two close tolerance washers. The entire assembly becomes an integral part of a connection. The inner concentric ring is thicker than the outer ring, and is compressed as the bolt is tightened. When the inner ring is compressed to the point where the outer ring binds against the adjacent washers, the desired preload has been automatically induced in the bolt.

DEFINITIONS OF OCCUPATIONAL SPECIALTIES IN ENGINEERING

A good book to consult for authorized definitions of approximately 500 occupational specialties in engineering.

Prepared by the ASME with the assistance of representatives of pertinent national Engineering Societies.

Published, 1951 **$2.50**

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When product designs for welded steel

Have twice the rigidity... three times the strength

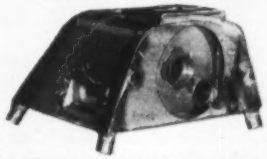
Yet require less material ...cost less to fabricate

WHY

aren't all your products designed for welding?

THE WELDED WAY

20% more rigid ...costs 44% less



Welded from 18 gauge sheet this power headstock weighs 28% less than cast iron design. Photo courtesy Oster Manufacturing Company, Cleveland, Ohio.

Let Lincoln show you how to duplicate these advantages in your products.

Write

THE LINCOLN ELECTRIC COMPANY

Dept. 4810 • Cleveland 17, Ohio

Creating Lower Cost for Industry... With Welded Steel

KEEP INFORMED — NEW EQUIPMENT, BUSINESS NOTES, LATEST CATALOGS

Hydraulic Systems

A 20-page illustrated catalog, Bulletin M5101A, describing oil-hydraulic systems and components for all mobile equipment in the truck and bus, construction machinery, material handling, agricultural and allied industries is now available from Vickers Inc., Box 302, Detroit 32, Mich.

The new catalog contains discussions of performance characteristics, design features, construction details and applications for single and double vane pumps, power packs for mobile equipment, multiple unit valves, relief valves, reservoirs, fluid motors and power steering boosters. Each section includes photographs, cutaway views and performance curves for the units under discussion. Specification tables are also included which show unit weight and delivery ratings for various recommended operating speeds and pressures.

Cold Water Deaerator

Cochrane Corp., 17th St., Philadelphia 32, Pa., has issued publication No. 4653 describing advantages of cold water deaerators and their principles of operation.

Included is data on reducing corrosion, deaeration without heating or cooling, and descriptions of the units.

Dichlorophene Data

A complete revised comprehensive bibliography of the literature on G-4 (dichlorophene) has just been published by Sindar Corp., 330 W. 42nd St., New York 36, New York.

The bibliography, Technical Bulletin D-2, contains abstracts of some 109 scientific trade articles, as well as abstracts of 12 patents both foreign, and domestic.

Torque Converters

Heavy-duty, single-stage hydraulic torque converters for transmission of 100 to 1000 hp to industrial machinery, are described in Bulletin No. 468 issued by National Supply Co., 2 Gateway Center, Pittsburgh, Pa.

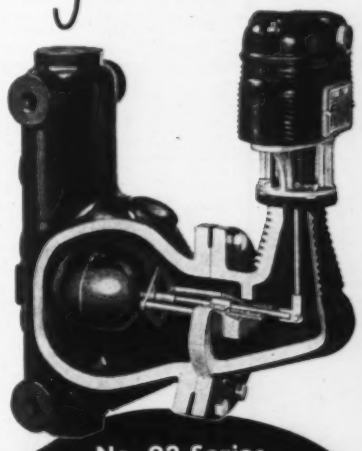
The bulletin gives features and specifications of 17 sizes and capacities of torque converters for exact matching with engines in this power range.

Storage Water Heaters

All standard lines of commercial and industrial storage water heaters made by The Patterson-Kelley Co., Inc., East Stroudsburg, Pa., are the subject of Catalog 19. The seven-color, 48-page catalog has been revised to include the latest provisions of the 1952 ASME Code for unfired pressure vessels.

Selection tables of capacities and weights, dimensions, hot water fixture capacities, material thicknesses, heating elements and construction details are offered, in addition to piping diagrams and valuable installation suggestions. Conversion tables are supplied to allow calculation of the capacities of heating elements under varying conditions.

McDonnell goes High Pressure



No. 92 Series Pump Control, Cut-off and Alarm Switch

For pressures to 250 psi.

- Repulsion magnetic switching—for positive opening *and* closing.
- Unprecedented heat dissipation—okayed for 75° C. (167° F.) wiring at terminals.
- Extra generous clearances in float chamber.
- Operating levels unaffected by pressure changes.
- McDonnell quality throughout.
- Four models—with or without integral water column.

Use this new 92 Series for controlling boiler feed pump, or electric valves; for low water cut-off or alarm; for tank level control, etc. For lower pressures—to 150 psi.—use companion 91 Series. New catalog has full engineering data.

Write for Bulletin L-123

McDONNELL & MILLER, *Inc.*

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Doing One Thing Well

McDONNELL

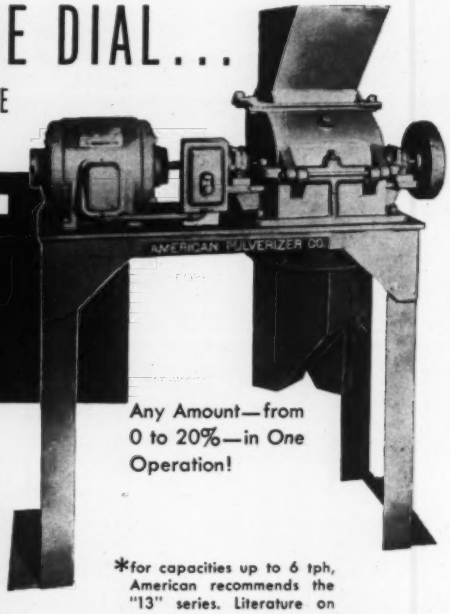
Boiler Water Level Control

JUST SET THE DIAL...

FOR A REPRESENTATIVE SAMPLE OF A SAMPLE

AMERICAN SAMPLE CRUSHER

WITH NEW ADJUSTABLE SAMPLING HOPPER



Any Amount—from 0 to 20%—in One Operation!

Does the job so quickly, efficiently, there's no loss of moisture content in sample.

FAST Up to 1 tph (Model 15 x 9); ½ tph for Model 9x9 (shown).*

EFFICIENT Once-through and the job's done!

LOW COST Practically no wear to an American Sample Crusher.

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American PULVERIZER COMPANY

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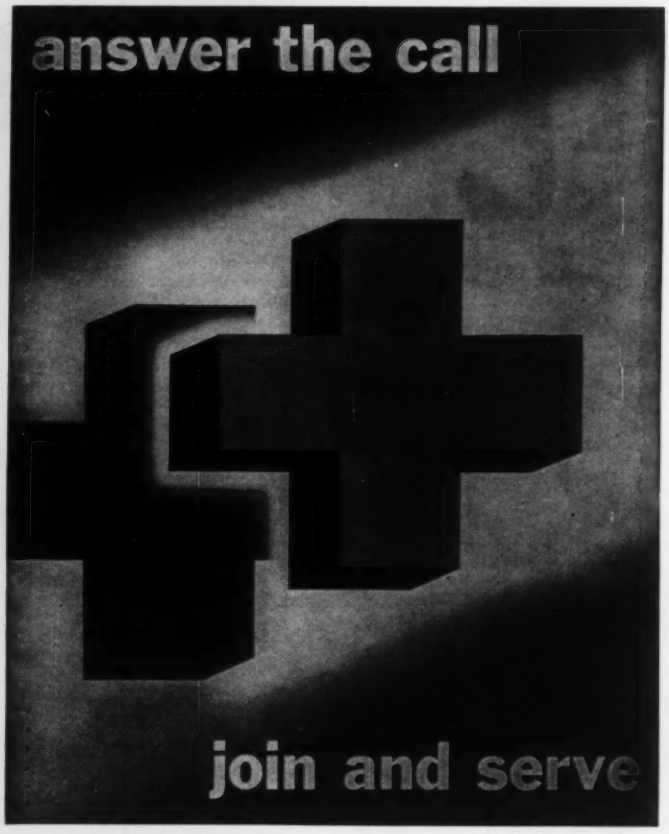


KEEP INFORMED — NEW EQUIPMENT, BUSINESS NOTES, LATEST CATALOGS

Microwave Packages

A 16-page descriptive brochure has been issued relating microwave communications equipment to different types of industry by Philco Corp., Government & Industrial Div., 4700 Wissahickon Ave., Philadelphia 44, Pa.

The booklet, which contains photographs and diagrams of actual microwave installations, describes typical expandable systems for 500, 120, and 90 miles. One system handles 48 voice channels. Specifications for new CLR-7 microwave equipment are included. In addition to voice frequency channels, provision may be made in the systems for the transmission of facsimile, program and high-speed data transmission.

Magnetic Motorized Valves

A 20-page catalog illustrating and listing specifications of magnetic and motorized valves for use with air, water, gas, steam, oil and refrigerants may be obtained from Mercoid Corp., 4201 Belmont Ave., Chicago 41, Ill.

Vulcanized Fibre

A four-page bulletin entitled "Engineering Materials To Improve The Design and Performance Of Your Product" is announced by National Vulcanized Fibre Co., 1056 Beech St., Wilmington 99, Del.

Described and illustrated are physical properties and use benefits of the company's two basic engineering materials—vulcanized fibre, a converted cotton cellulose, and Phenolite laminated plastic, a family of thermosetting high pressure laminates. Sixteen photographs and drawings illustrate such uses as noiseless gears, thrust washers, cams, terminal blocks, armature slot insulation, shock plates in gun mounts, printed circuits, abrasive wheels, textile bobbins, waste baskets, fuel pumps, carburetors, propeller pitch controls, athletic equipment, luggage, and material handling receptacles. Tables list grades, specifications, characteristics, and applications.

Unified Threads

A quick explanation of unified screw threads, in simple language and illustrations, has been prepared in a four-page folder by Cleveland Cap Screw Co., Box 558, 2917 E. 79th St., Cleveland 4, Ohio.

The folder cites the profile origins of the unified threads adopted in 1948 by United States, Britain and Canada, the minor changes in threads per inch from American Standards, the advantages of thread tightness and interchangeability.

A copy of the folder may be had by writing Mrs. Jo Kinney, advertising manager, The Cleveland Cap Screw Co.

KEEP INFORMED

NEW EQUIPMENT
BUSINESS NOTES
LATEST CATALOGS

Rigid Koroseal Pipe

An eight-page illustrated bulletin on its line of high impact rigid Koroseal pipe, fittings and valves has been published by B. F. Goodrich Co., Plastic Products, Marietta, Ohio.

The brochure explains how the pipe is installed, reviews product applications and describes physical properties. Also described is the use and installation of Koroseal valves. The back page is devoted to a chart listing common chemicals handled by the pipe, fittings and valves.

Welding Catalog

Modern Engineering Co., Dept 204, 3407 Pine Blvd., St. Louis 3, Mo., has announced the 1956 revision of its No. 150 general welding catalog covering its complete line of oxyacetylene welding and cutting torches, machine cutting torches, regulators, pressure gages, hose connections, couplings and safety equipment.

Coated Abrasives

A 10-page booklet illustrating how several leading appliance manufacturers are cutting costs and improving finishes with coated abrasives in various forms is available from Minnesota Mining & Mfg. Co., Dept. F6-189, 900 Fauquier St., St. Paul 6, Minn.

Entitled "Grinding and Polishing Appliances with 3M Coated Abrasives," the booklet makes case history presentations of several abrasive operations, including prefinishing, weld grinding and blending, removing imperfections, and finishing and polishing. Types of coated abrasives illustrated in use are belts, sheets, disks and polishing and grinding wheels.

Injection Molding Machine

Design features of the new Model 701 2-oz automatic injection molding machine are portrayed in an eight-page brochure, Bulletin 565, issued by the Plastics Molding Equipment Div., of F. J. Stokes Corp., 5500 Tabor Rd., Philadelphia 20, Pa.

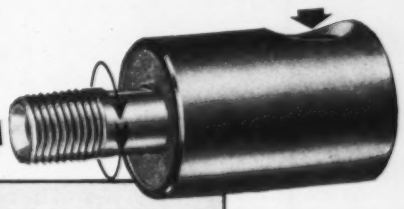
A series of closeup photographs shows the complete sequence of automatic ejection and de-gating in the machine and the action of the separator plates which sort the molded and trimmed pieces from the sprues and runners automatically.

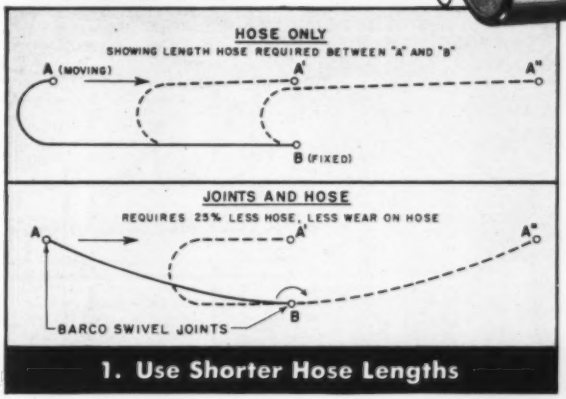
Floating Roof Seal

A catalog and data book on the patented "Tubeseal" system for floating-roof storage tanks has just been published by Hammond Iron Wks., 630 Fifth Ave., New York 20, N. Y.

The catalog describes the design and construction of the improved unit, said to be the only floating-roof seal that completely eliminates every space between seal and product. This is the area in conventional floating-roof tanks where air-vapor mixtures form, the firm says.

SINGLE PLANE
New Barco help cut HOSE COSTS
SWIVEL JOINTS





Straight or Angle Connections

1. Use Shorter Hose Lengths

For Hydraulic or Pneumatic Service

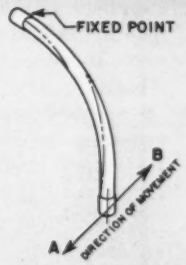
HERE is a real opportunity for product designers and machinery builders to CUT HOSE COSTS. Barco's new Single Plane Swivel Joints are especially suitable for use as *leakproof* flexible connectors (either angle or straight) wherever hose moves, bends, or twists.

- *Key to Better Engineering!* Often possible to eliminate long radius bends—get neat, space-saving installations (See Fig. 1). Eliminate torsional working stresses that cause fatigue and failure in pressure hose (See Fig. 2).
- *Economical!* These new Barco joints are small, light, and inexpensive. They turn with very low torque under pressure.
- *Sealed, Unitized Construction.* Built with ball-bearing or thrust bearing. O-ring seal. Choice of styles; sizes ¼", ½", ⅜", ¾". For service to 2,000 psi, −20° to 225°F. Other types available for higher ratings.

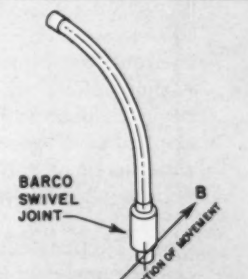
GET THE FACTS NOW!

For complete information, see our nearest representative, or write. ASK FOR NEW CATALOG SHEET No. 406A.

2. Get Longer Hose Life



-WITHOUT SWIVEL JOINT.
HOSE TWISTS



-WITH SWIVEL JOINT.
HOSE DOES NOT TWIST

BARCO MANUFACTURING CO.

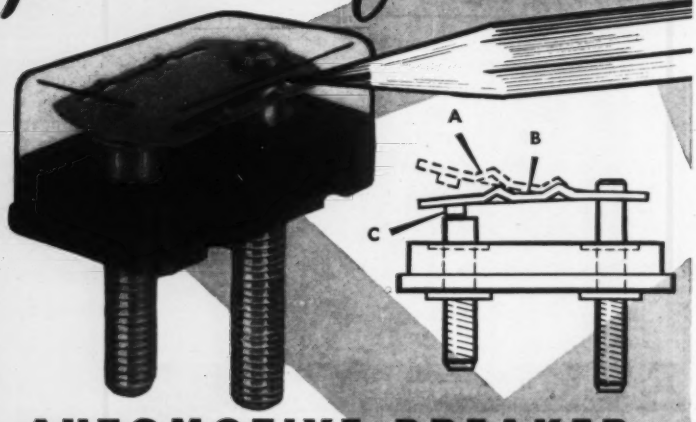
BARCO

521-K Hough Street
Barrington, Illinois

In Canada: The Holden Co., Ltd., Montreal

HOW CHACE THERMOSTATIC BIMETAL ACTUATES THE

Precision Controls



AUTOMOTIVE BREAKER

This miniature breaker, manufactured by Precision Controls Co., for leading automobile manufacturers and their suppliers of electrically operated equipment, protects headlights and devices such as window lifts, power seats and other circuits in our highly automatic motor cars. Available in 6, 12 and other voltages, it may be calibrated for various amperages to meet requirements. All forming, stressing and calibration is done automatically. Strict statistical control is exercised in its manufacture to assure uniformity. The actuating element, of course, is reliable Chace Thermostatic Bimetal.

Here's how it works: The die which pierces the two slots in the bimetal is followed by a die which forms the two crimps in the narrow strips (A) at each side of the element. Since this shortens the strips, the main portion of the element (B) is compressed into an "oil can". The thermostatic bimetal element carries the normal circuit without effect while an overload causes the bimetal to begin to deflect; but the contacts (C) open only when the "oil can" snaps past center. This provides a desirable time delay to handle heavy starting loads and the snap action when there is a short circuit prevents arcing.

Chace Thermostatic Bimetal is available in 28 types, in strip, coil or completely fabricated and assembled elements made to your specification. Write for *new* 44-page booklet. "Successful Applications of Chace Thermostatic Bimetal," containing interesting uses of bimetal, formulas, calculations, etc.

W. M. CHACE CO.
Thermostatic Bimetal
1619 BEARD AVE., DETROIT 9, MICH.

KEEP INFORMED — NEW EQUIPMENT · BUSINESS NOTES · LATEST CATALOGS

Centrifugal Dust Collector

A bulletin on a recently developed multiple tube dust collector has been issued by Research-Cottrell, Inc., Bound Brook, N. J. The unit operates on centrifugal collection principles and incorporates new design features to boost collection efficiency and gas handling capacity.

The 12-page illustrated bulletin explains the operation and construction of the Cyclotrell with the aid of numerous drawings, cutaway views, and collection efficiency and capacity nomographs. Tables give design data for the six available sizes of the unit, ranging from 3 to 20 tubes.

Fluid-Tight Rivet

A six-page brochure containing data on the firm's Fluid-Tight rivet series, is announced as available by Pastushin Industries, Inc., 5651 W. Century Blvd., Los Angeles 45, Calif.

The two-color brochure offers technical descriptions, photographs and charts, of the firm's self-sealing rivet principle. Under this principle all leak areas are sealed automatically by extrusion, or flow, of an aluminum alloy sleeve when the rivet is expanded during driving. The seal is attained without use of calking or rubber-sealing agents.

Instrument Panels

Instrument and control panels are described in a 16-page Product Specification G71-7 available from Bailey Meter Co., 1050 Ivanhoe Rd., Cleveland 10, Ohio.

The units are completely tubed and wired, ready to plug-in on arrival.

Propeller Fans

A revised catalog, Bulletin A-109B, covering its line of propeller fans has been published by the Hartzell Propeller Fan Co., Piqua, Ohio.

The catalog contains new fan sizes not shown in the previous edition as well as revised air deliveries, specifications, performance data and dimensional drawings on the entire line. Standard propeller, utility, cool-blast, Lo-Noise, reversible and Bi-Pass duct fans, intake air units and unit heaters are shown.

Wire Rope Endings

A four-page folder, DH-531, has been prepared and released by the Wire Rope Sling Dept., American Chain & Cable Co., Inc., Wilkes-Barre, Pa., to describe its Dualoc wire rope endings through typical application photographs.

According to the manufacturer, Dualoc is a modern wire rope ending with a thimble or loop. It is double-locked for strength and security. It has been accepted and used by public utilities, the railroad industry, oil riggers, the marine industry, all branches of the military, and for materials handling applications.

KEEP INFORMED

NEW EQUIPMENT
BUSINESS NOTES
LATEST CATALOGS

Leaded Steel

Alco Products, Inc., Box 1065, Schenectady, N. Y., has announced the availability of an eight-page bulletin on the company's production of seamless forged and rolled rings from its new Hi-Qua-Led leaded steel.

The illustrated booklet points up advantages of using the leaded steel and contains test data and microstructures showing the even lead distribution and machining characteristics of the product. Included in the test data is a chart of the physical properties of the material in 11 grades and section sizes.

Plastic Couplings

Plastic couplings are the subject of an illustrated, four-page folder now available from Johns-Manville, 22 E. 40th St., New York 16, N. Y.

Time saving and money saving advantages of the couplings for Transite ducts used in telephone conduit lines are described. On-the-job photographs show installations in various sections of the country. Also shown are some of the various methods of installing and positioning Transite conduit and Kor-duct which plastic couplings make possible.

Engineering Drawings

A new series of engineering drawings incorporating the latest technology in construction methods for acid resistant brick installations is available from Pennsylvania Salt Mfg. Co., 3 Penn Center Plaza, Philadelphia 2, Pa.

Graphically diagrammed are details of acid proof masonry construction for six typical installations: a pump base, column pad, tank outlets, bell and spigot joints, floors and trenches.

Carbon Steel Tubing

A six-page technical folder on electric resistance welded carbon steel tubing in applications involving heat transfer has been released by the Tubular Products Div., Babcock and Wilcox Co., Beaver Falls, Pa.

A chart outlining the hydrostatic test pressures required for various sizes of tubes under ASTM A-214 is also shown. The folder is designated TB-412.

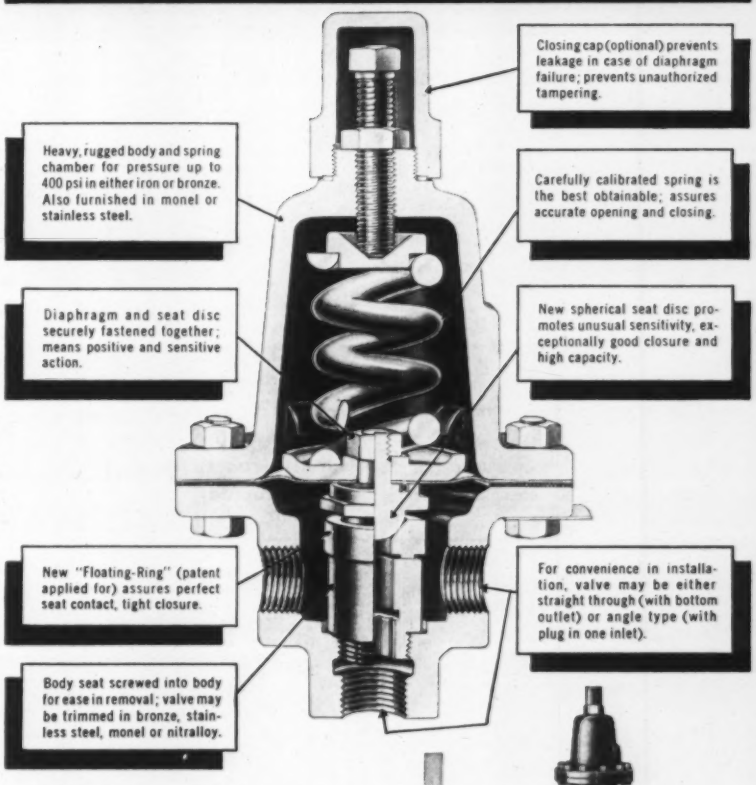
Splicing Kits

A new 12-page booklet containing instructions and application information for the entire line of "Scotchcast" brand splicing kits has been announced by Minnesota Mining & Mfg. Co., Dept. D6-196, St. Paul, Minn.

The illustrated four-color booklet describes in detail the "Unipak" container of electrical insulating resin No. 4 for pouring field-encapsulated splices and the three types of splicing kits with which it is used.

Split mold splicing kits for making in-line splices for weather exposed or direct burial locations, kits for making wye or tap splices with a split-mold are included.

how Cash-Acme provides the Correct Answer to high back pressure valve maintenance costs


Closing cap (optional) prevents leakage in case of diaphragm failure; prevents unauthorized tampering.
Heavy, rugged body and spring chamber for pressure up to 400 psi in either iron or bronze. Also furnished in monel or stainless steel.
Carefully calibrated spring is the best obtainable; assures accurate opening and closing.
Diaphragm and seat disc securely fastened together; means positive and sensitive action.
New spherical seat disc promotes unusual sensitivity, exceptionally good closure and high capacity.
New "Floating-Ring" (patent applied for) assures perfect seat contact, tight closure.
For convenience in installation, valve may be either straight through (with bottom outlet) or angle type (with plug in one inlet).
Body seat screwed into body for ease in removal; valve may be trimmed in bronze, stainless steel, monel or nitralloy.

Here's How: When Cash-Acme's engineers designed the Type FR Back Pressure Relief Valves, they put *your* rising maintenance costs foremost in mind . . knowing that "down time" is extremely important. This superior valve series, therefore, is built to *exacting* specifications, featuring the nearest thing to *friction-free* operation as is possible to attain, which means less wearing of parts, longer life.

Do as other cost-conscious engineers and purchasing men are doing and switch to CASH-ACME.

A fact-jammed bulletin, with honest and accurate capacity charts, is available free of charge. Write today.

TYPE "FR"—Rugged Industrial Type Back Pressure Relief Valve, automatically maintains correct pressure on inlet, relieving to a lower pressure or to atmosphere. For 0 to 400 psi; ½" to 2" pipe sizes. Suitable for:

- AIR • WATER (Hot or Cold)
- GASOLINE
- OIL (Light or Heavy)
- FUEL TAR • AMMONIA
- FREON • BRINE • CO_2
- FISH OIL • NITROGEN
- HYDROGEN • ALCOHOL

Modified for:

- VACUUM RELIEF
- CONSTANT DIFFERENTIAL REGULATOR

FOR THE *Correct Answer*

CASH AUTOMATIC VALVES ACME

A. W. CASH VALVE MANUFACTURING CORP.
6627 East Wabash Avenue
Decatur, Illinois

Select California engineering group explores thermodynamic cycles in advanced engines

A Few Positions Still Open For Cycle Analysis—Thermodynamics—and Nuclear Engineers.

Propulsion experts at North American Aviation, Los Angeles Division are carrying out thermodynamic analyses of highly advanced engines at the company's Los Angeles, California plant. The studies include investigation of turbojets, ramjets, rockets and nuclear propulsion devices . . . compressors, combustors, turbines, afterburners, exhaust nozzles and thrust augmentation devices.

The Engineering Personnel Department at North American's Los Angeles Division, Engineering Department is seeking several qualified engineers who are interested in this work. They are looking for men who have had a minimum of three years' thermodynamics cycle analysis experience with jet engines or propulsion analysis. Advanced degrees are preferred, though not required.

Interested engineers are invited to contact Mr. W. H. Nance, Department 56-ME, Los Angeles Division Engr. Dept., North American Aviation, Inc., International Airport, Los Angeles 45, California.

You could call this "the hi-sign of good government". . . or "taking aim on the right candidate". . . or "eyes right on better representation". Whatever you call it, it's the right idea. The idea is to vote . . . and get your friends to vote. Make *sure* the candidates elected in November are the ones who will best represent *you*. Argue, read, talk, study, listen, think, persuade, decide, and then finally—

VOTE NOV. 6

THE AMERICAN HERITAGE

PUBLIC SERVICE ADVERTISING COUNCIL

KEEP INFORMED — NEW EQUIPMENT BUSINESS NOTES LATEST CATALOGS

Fork Lift Trucks

A 52-page product catalog is now available from Mercury Mfg. Co., 4044 S. Halsted St., Chicago 9, Ill. The book includes specifications and illustrations of the firm's line of current model fork lift trucks, platform lift trucks, load carrying trucks and industrial tractors and trailers.

The equipment listed in Catalog 400 is designed for use in such industries as automobile, aviation, food, metalworking, paper, petroleum, railroad, textile and woodworking.

Nuclear Power Film

"Atoms for Peace," a new 16-mm color sound film which tells why electric power produced by atomic fission is receiving so much attention, is being made available to interested groups by Allis-Chalmers Mfg. Co.

The film is based on Allis-Chalmers model of the experimental boiling water reactor being built by the Argonne National Laboratory. Requests for prints of "Atoms for Peace," which runs 18 minutes, should be made to the nearest Allis-Chalmers sales office.

Hydraulic Valves

Commercial Shearing and Stamping Co., 1775 Login Ave., Youngstown 1, Ohio, has issued a 92-page booklet on oil hydraulic valves for controlling fluid power when used to control the operation of cylinders and motors.

Performance data, capacities, types, sizes, details and mounting dimensions are given, along with illustrations of installations, cutaway drawings, and flow schematics.

Electric Heaters

A revised catalog, 27-620, that describes industrial electrical heating units and devices is available from Westinghouse Electric Corp., P.O. Box 2099, Pittsburgh 30, Pa.

The catalog contains information and design selection charts on strip heaters, natural and forced convection air heaters, oven heaters, immersion heaters, cartridge heaters, melting pots, industrial hot plates, and heater control equipment. Information about selection of many special types is also included.

Service Cocks, Meters

A line of service cocks, meter and air cocks for such moderate-pressure services as gas, water and utility services is described in a 12-page bulletin, V-605, issued by Rockwell Mfg. Co., 400 N. Lexington Ave., Pittsburgh 8, Pa.

The cocks described are also recommended for use in a number of low-pressure industrial applications. Principal emphasis is given to the "1092" tamper-proof service cock specially designed to eliminate the menace of tampering where a curb installation is involved, or an installation beside the meter or at some other exposed location.

KEEP INFORMED

NEW EQUIPMENT | BUSINESS NOTES | LATEST CATALOGS

Copper Clad Data Book

A 16-page copper clad technical data book has been released by Formica Corp., subsidiary of American Cyanamid, 4614 Spring Grove Ave., Cincinnati 32, Ohio.

It explains the principles and some of the problems of printed circuitry. It advises on the proper selection of laminates, and tells how to make a printed circuit using both photo engraving and silk screen methods, and covers the subjects of plated circuits, plating through holes, flush circuit production and circuit fabricating.

Sprayable Plastisol

A four-page illustrated bulletin now available from Metal & Thermit Corp., Rahway, N. J., describes the company's latest development in sprayable plastisols, Unichrome "Super 5300" plastisol coating. The bulletin explains how the plastisol can be sprayed in coatings up to 60 mils thick in a single application, even to cold vertical surfaces.

According to the bulletin, the coatings protect acids, alkalies, salt solutions and complex chemical compounds.

Air Hose Bulletin

A two-page bulletin on its line of air hose has been published by the B. F. Goodrich Industrial Products Co., Akron, Ohio.

The bulletin brings data on the firm's air hose up-to-date, especially on Maxecon All Purpose hose, now made in a complete size range for use as an air, water and gasoline hose. Other hose reviewed includes: Highflex, recommended for bench work and small shop tools; Type 50, recommended for tie tamping, compressor service, ore mining, quarry service; Commander, recommended for uses in mines and quarries; Type 88, an air, manifold and jetting hose recommended for heavy duty service in mines and quarries where tools are oiled through the hose and abrasion on cover is severe.

Wire Rope Applications

Macwhyte Co., Kenosha, Wis., has issued a bulletin, No. 5647, showing wire rope applications in a helicopter, a water well drilling operation, a sling lift, a water tower dismantling operation, and several elevator installations. Various types of swaged fittings are also shown.

Water Chiller Bulletin

Vertical Shaft Motors Bulletin GEA-6521, six pages, discusses design features and performance of new pump motors, $7\frac{1}{2}$ through 30 hp, for farm and industry. Copies may be obtained from General Electric Co., Schenectady 5, N. Y.

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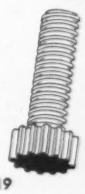


19

HORSPOOL & ROMINE MANUFACTURING CO., INC.
5850 MARSHALL ST., OAKLAND 8
TELEPHONE OLYMPIC 2-1844

NEW METER-RELAYS
FROM 0-5 MICROAMPERES-UP
Ruggedized - Sealed, Black Bakelite or Clear Plastic Cases

D'Arsonval meters with locking contacts for sensitive and accurate control or alarm.

Model 461-C, 10-0-10 Ua DC $83.25

TRIP POINT ADJUSTABLE to any point of scale arc. Sensitive to changes as little as 1%. One contact on moving pointer. The other on adjustable pointer. When pointers meet, contacts close and lock. Holding coil wound on moving coil. Locking is electro-magnetic. Manual or automatic reset. Spring action kicks contacts apart.

Ranges: From 0-5 microamperes, 0-5 millivolts or 0-300°F up.

Standard Contact Rating 5 to 25 milliamperes DC. Can be up to 100 milliamperes DC.

Ruggedized-Sealed metal cases, 2½", 3½" or 4½" round, shock-mounted movement, gasket-sealed.

Black Bakelite case, 4½" rectangular.

Clear Plastic cases, 2½", 3¾" or 4½" rectangular.

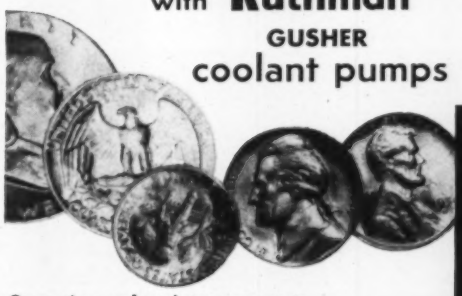
Model 255-C, 0-10 V DC $42.50

Panel meters and indicating pyrometers also in ruggedized-sealed, black bakelite or clear plastic cases. Write for new 40 page Catalog 4A on meter-relays, meters, pyrometers and automatic controls.

Assembly Products, Inc., Chesterland 59, Ohio. HAmilton 3-4436 (West Coast: Desert Hot Springs 59, Calif. Phone: 4-3133 & 4-2453).

Booth 1614, Instrument-Automation Show, Sept. 17–21

SAVE TIME and MONEY
with Ruthman GUSHER coolant pumps



This milling machine, manufactured by George Gorton Machine Company, is equipped with a Ruthman Gusher Coolant Pump in back of the column.

Operating and maintenance costs are reduced when you specify Gusher Coolant Pumps. You get split-second coolant flow . . . controllable as to volume. There is no priming or packing needed. Heavy-duty pre-lubricated ball bearings and electronically-balanced rotating shaft give you long life with minimum cost of maintenance. We will be glad to advise you on your coolant problems.

Model 5-P 3

THE RUTHMAN MACHINERY CO.
1823 Reading Road Cincinnati, Ohio

There are still a lot of problems to be solved in the design of any reactor. But the difficulties are multiplied many fold when it comes to developing a practical nuclear aircraft engine. Shielding, weight limitations, other factors make it one of the toughest engineering problems of today.

Are you the type of engineer who wants a challenge to his mental abilities? Are you looking for an opportunity to do original, creative thinking on an outstanding engineering team where new ideas are encouraged? Then we may have an interesting, profitable future for you here, particularly if you are an . . .

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World's foremost designer and builder of aircraft engines . . . .

KEEP INFORMED — NEW EQUIPMENT, BUSINESS NOTES, LATEST CATALOGS

Bronze Gate Valves

Kennedy Valve Mfg. Co., E. Water St., Elmira, N. Y., has issued a bulletin No. 566, describing and illustrating its new 125-lb bronze gate valves, Fig. 427, Fig. 427 SJ, and Fig. 427 BS.

The valves feature cylindrical design and increased weight construction and completely interchangeable parts in valves of the same size. They are available with either screwed brazing socket, or solder joint ends.

Reheat Turbine Design

An eight-page leaflet discusses the evolution of Allis-Chalmers reheat turbine designs and contributing reheat experience during the last 25 years.

The leaflet carries installation photos and cross section drawings of the units as well as cross sections through a barrel-type turbine for supercritical pressure application. Copies of bulletin 03R8467 are available on request from Allis-Chalmers Mfg. Co., 949 S. 70th St., Milwaukee, Wis.

Dihedral Couplings

A catalog, No. 62, covering Series D-100 standard, floating shaft and mill motor type dihedral couplings has been published by the Ajax Flexible Coupling Co. Inc., Westfield, N. Y.

Working data is given on sizes, capacities and dimensions of the couplings designed to handle angular and offset misalignment up to a total of 12 deg.

Wool Felt Filtration

American Felt Co., Glenville, Conn., is making available a 10-page, comprehensive technical data sheet which sets forth the advantages of wool felt for liquid filtration, based on the company's entire range of wool filter felts.

The data sheet is the 17th in a series describing the end uses of the firm's products and explains with charts and diagrams the properties and characteristics which make wool felt filters desirable. The standard line of liquid filter felts presented in the data sheet is declared to provide efficient and economical filter media for cellulose nitrate, solvents, hot lubricating oil, paint, latex, water, food syrups and oils.

Centrifugal Pump

A new catalog sheet describing the new "Flex-Seal" centrifugal pumps is available from Bart Laboratories, 229 Main St., Belleville, N. J.

The literature describes a new two-piece seal which can be installed or replaced by any shop workman and requires no further adjustments. The seal, which is constructed entirely of extra low carbon stainless steel, is also shown in an "exploded view" that facilitates following operating and service instructions. A special rate of flow chart indicates the capacities and flow rates of the models now in production.

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Copper Tape Chart

What is said to be the first chart ever published that enables engineers to convert from conventional round copper wire to the new copper tape for use in wafer-type coils is available from American Silver Co., 36-07 Prince St., Flushing 54, N. Y.

The chart lists the gage, diameter, and cross-sectional areas of standard copper wires together with the equivalent width of copper tape in thicknesses from 0.00017 to 0.001 in. The chart is designed to simplify the specification of copper tape wherever it replaces copper wire.

Self-Locking Fasteners

A catalog describing the firm's line of one-piece self-locking fasteners is available from Nylok Corp., 475 Fifth Ave., New York 17, N. Y.

The locking principle used in the fasteners consists of a nylon plug imbedded permanently in the threaded section. It can be applied to any male or female threaded part, to make a positive, leakproof joint which cannot be jarred loose by shock or vibration. Nuts, bolts, and screws eliminate the need for lock washers, jam nuts, safety wiring or other locking devices.

Tube Expander

Availability of Catalog 81 has been announced by Gustav Wiedeke Co., 1833 Richard St., Dayton 1, Ohio.

This 32-page catalog contains specifications of the firm's product line of Ideal tube cutters and expanders, plus information pertaining to a complete line of operating accessories. Along with 300 illustrations, the book contains tables of sizes, ordering information and a list of nationwide and foreign distributor locations.

Recording Equipment

Information describing the new oxygen sampling and recording equipment specifically designed for continuous O_2 analysis of open-hearth waste gases is available in an illustrated, four-page process data sheet published by Leeds & Northrup Co., 4934 Stenton Ave., Philadelphia, Pa.

The sheet, No. 643(5), presents a complete description of the sampling probe, steam jet sampling system, and the O_2 analyzer and Speedomax G recorder. It includes itemized listing and specifications of the entire equipment "package."

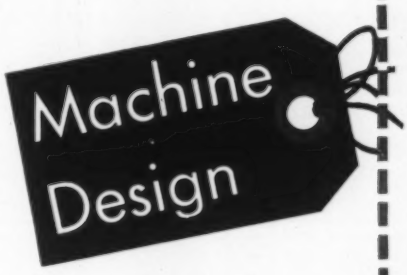
Deaerating Water Heater

Publication 4654, describing a deaerator design best suited for hot water line protection in office buildings, hotels, hospitals and industrial plants, is available from Cochrane Corp., 17th St., Philadelphia 32, Pa.

This publication tells why this type of deaerator economically provides a supply of hot water free from objectionable odor or taste that might be due to steam and fully deaerated to prevent corrosion.

Machine Design
ENGINEERS:

Tie in with the fast-growing electronic computer field!



PRODUCT DESIGN

Develop complex, high-speed mechanisms, gear trains, cams, linkage systems.

Design packaging for unitized and miniaturized assemblies and printed wiring.

Evaluate functional performance of mechanical units by measuring motion, stress, strain, shock, etc., with oscilloscope, stroboscope, strain gauge, high-speed photography and other precision techniques.

TOOL DESIGN

Analyze tooling requirements and design new tools for production and assembly of precision parts.

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Develop new methods for production of complex precision parts.

Develop automated production assembling and testing machinery.

APPLY your engineering ability to a stimulating position at IBM, where your growth is virtually unlimited.

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IBM leadership is based on a record of solid achievement and growth. During 1955, IBM announced a major data processing improvement on the average of *every two weeks*. IBM Engineering Laboratory personnel increased five-fold in the past five years!

Third, excellent salaries and benefits.

Personnel turnover is less than one-fifth of the national average!

Fourth, advancement based solely on merit.

IBM engineers work in small teams, where individual contributions are quickly recognized and rewarded!

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Cabled Tubes

A 12-page, two-color technical bulletin on cabled tubes for instruments and controls has been issued by Crescent Insulated Wire and Cable Co., Trenton, N. J.

The bulletin gives information on various types of Multitube and methods of installation. Illustrations show regular copper and polyethylene tubes, as well as four different corrosion-resistant types. Also described is a relatively new method of utilizing armored cable instrument tubing to provide better protected instrument lines at substantial saving in cost.

Fluid Drive Bulletin

An eight-page illustrated two-color catalog (Bulletin 9819) describing new 1 through 25 hp Type VS Class 2 Gyrol fluid drives is available from American Blower Corp., Detroit 32, Mich.

The catalog discusses advantages and typical applications of the new adjustable speed fluid drives. Design and general construction features are described and illustrated with a cutaway view. Close-up photographs of optional speed control mechanisms are included. A description of the operation of the new units is also given.

Steel, Alloy Tanks

Graver Tank & Mfg. Co., Inc., East Chicago, Ind., is issuing a quarterly magazine containing case histories of steel and alloy tanks and vessels in industrial uses, chiefly in recently built plants and refineries.

The magazine, called the "Echo," includes in its current issue stories and photos on storage vessels for liquid oxygen, an ammonia stripper tower, petroleum tanks, water treating equipment, and oilfield production tanks and treaters.

Humidity Instruments

A bulletin, H1009, which describes and illustrates the company's line of humidity recording and controlling instruments and accessories, has been announced by Bristol Co., Waterbury 20, Conn.

The two-color, 22-page bulletin contains information on indicating, recording, and automatically controlling wet and dry bulb instruments, and psychrometers (direct reading type). Models for permanent mounting in various types of installations, as well as portable models are shown. Accessories, include wet bulb fixtures, valves, and motor operators for louvers, ducts. Also included are conversion tables of wet and dry bulb temperatures and psychrometric tables.

Heating System Pumps

A four-page illustrated bulletin No. H-1, describing design and construction features of NCR single and NCRD duplex condensate return pumps is available from C. H. Wheeler Mfg. Co., Economy Pump Div., 19th and Lehigh Ave., Philadelphia 32, Pa.

Folder includes photos, dimension drawing, selection tables, and operating data. These pumps, specially designed for low pressure steam heating systems, handle condensate up to 200 F. They can be operated at a wide range of pressures without overloading the motor. They are furnished with $\frac{1}{3}$, 1, or $1\frac{1}{2}$ hp 3500 rpm ball bearing, open drip-proof motors.

Diaphragm Valves

A 16-page, two-color catalog, G-56, featuring diaphragm valves and metering and proportioning pumps has been released by Hills-McCanna Co., 2433 W. Nelson St., Chicago, Ill.

Included are specifications on diaphragm valves, tables of capacities on metering and proportioning pumps and information including a schematic diaphragm of a precision pump for precision metering.

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Know-How—
...HAS MADE
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WIRE FORMS
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In Industry, in homes, farms and shops, you'll find daily, living proof that D-&-B's KNOW-HOW pays out in EXTRA performance. Rely on expert engineers for parts that meet your exact needs and save you MONEY! Get Wire Forms, Springs and Stampings that are easily assembled . . . that withstand stress . . . and perform under the most trying conditions!
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Gaskets and Tapes. Making gaskets and tapes from top quality Asbestos Wire Inserted Cloth is a Rhopac specialty. Specify Rhopac boiler gaskets, folded tapes (plain or tadpole), and retort door packing. Prompt service — low prices.
Sheet Gasket Materials. All standard gasket materials in various thicknesses kept in stock at all times — available in sheet or roll form. Your order will receive immediate attention.
Rhopac Packing Hooks. A packing extractor whose flexible shaft greatly simplifies the removing of old, worn-out packing. In set of 3 handy sizes — other sizes available. A great time and labor saver.
Mechanical Packings. We stock a wide selection of high temperature, high pressure and all standard types of packing. Special requirements are also developed and produced on short notice.
See Rhopac on All Gasket and Packing Problems
Exceptional Service — Top Quality
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Manufacturers of mechanical packings, industrial and boiler gaskets, steel rule dies, flexible packing hooks

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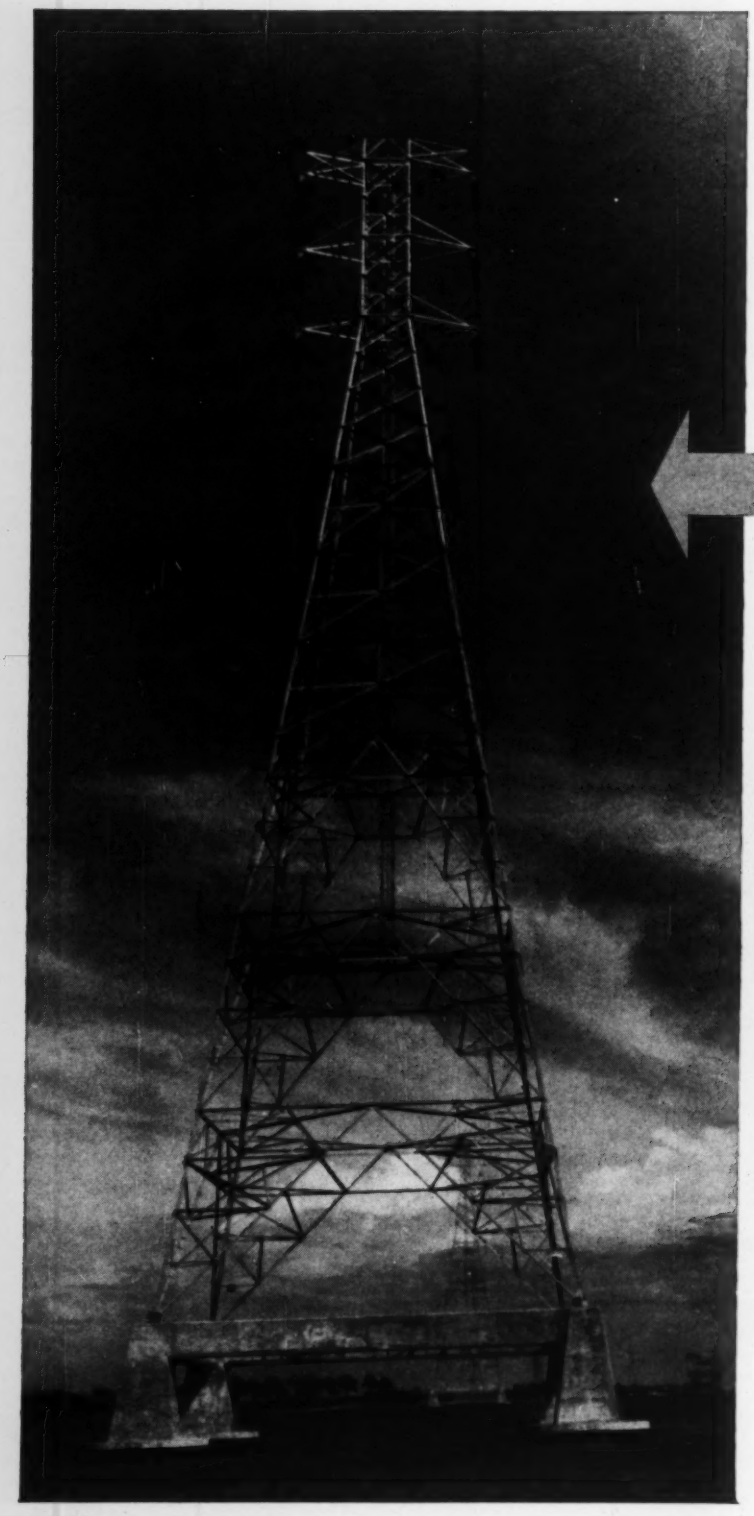
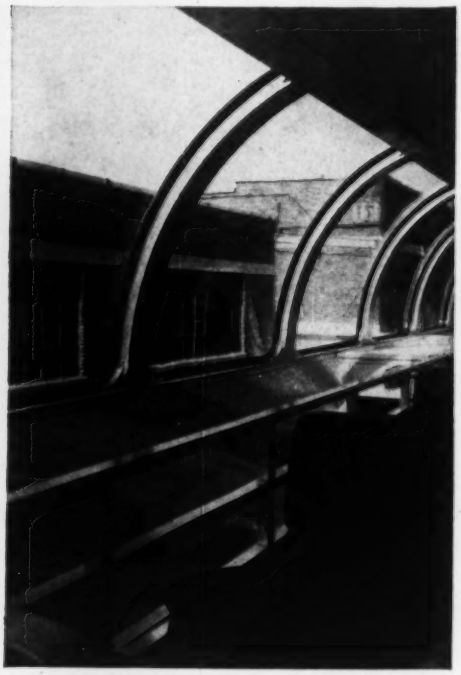
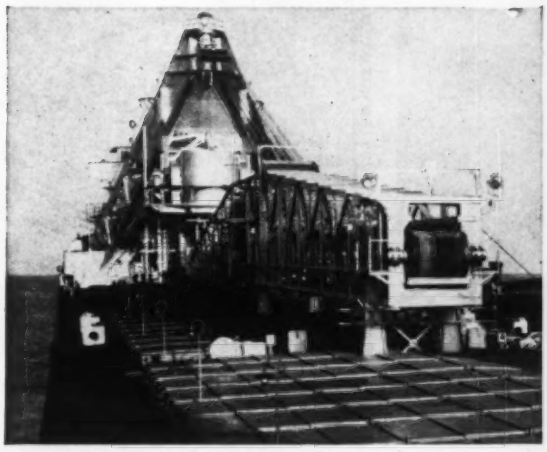


ERECTION COSTS REDUCED $7,200 by using USS MAN-TEN Steel rather than carbon steel in the legs of four 198 ft. transmission towers that carry power lines across Old Tampa Bay, Florida. Six tons of weight saved by MAN-TEN Steel in the East Bank tower saved $1,200 in erection cost. The 6½ tons saved in each of the three towers erected in the Bay saved $6,000 more. The total of 26 tons of steel saved by using MAN-TEN Steel also reduced the cost of the material used in the towers, even though MAN-TEN Steel costs a little more per lb. (Towers designed and fabricated by American Bridge Division of United States Steel for Florida Power Corporation, St. Petersburg, Fla. Erected by Southeastern Utilities Service Co., Miami, Fla.)



THE SUPERIOR STAMINA and corrosion resistance of USS COR-TEN Steel save power by saving weight, insure minimum maintenance and longer service life in this full-length "dome" lounge car built for the Milwaukee Road by Pullman-Standard Car Manufacturing Company, Chicago, Ill. More than 6,000 modern passenger cars and 190,000 freight cars of all types have been built to date with USS COR-TEN Steel.

with USS High Strength Steels



USED IN THE LOADING BOOM and supporting "A" frame of this self-unloading cargo vessel which can discharge 4,500 tons of limestone per hour, USS TRI-TEN "E" Steel not only materially increases the strength and durability of the structure but saves more than 18,000 lbs. of weight. 50,000 lbs. of TRI-TEN "E" Steel in plate and structural form were used in this application. (Designed by Robins Engineers, Division of Hewitt-Robins, Incorporated, for Manitowoc Shipbuilding, Incorporated.)

WEIGHT WAS REDUCED 10% yet strength-to-weight ratio was increased over former construction by using USS MAN-TEN Steel in the arch boom, "A" frame and tongue of this heavy-duty logging unit. The increased strength provided by MAN-TEN Steel makes it possible to handle log loads of maximum size—the reduced weight ensures greater mobility and maneuverability. Result: more footage, handled faster. (Designed and built by Hyster Company, Portland, Ore.)

IN USS HIGH STRENGTH STEELS, design engineers have at their command three service-tested steels that will permit them to materially increase the efficiency and economy of machinery, equipment and structures at little or no increase in first cost . . . and frequently, at a saving.

All three of these famous "steels that do more" – USS COR-TEN, USS MAN-TEN and USS TRI-TEN – have a 50% higher yield point than ordinary carbon steel. All have better corrosion resistance and offer greater resistance to wear, fatigue and impact. Each, however, has specific superior properties that should be considered in determining its selection.

USS COR-TEN Steel, for example, is distinguished by its superior resistance to atmospheric corrosion—4 to 6 times that of carbon steel. USS MAN-TEN Steel is intended for weight reduction by means of greater strength in moderate forming applications, with enhanced resistance to abrasion and atmospheric corrosion. USS TRI-TEN Steel's outstanding characteristics are excellent weldability and resistance to shock at low temperatures.

Used singly or in combination, these steels can advantageously replace carbon steel to increase the strength and durability of vital parts *without* increasing their weight. Or when the use of thinner sections is feasible they can (1) reduce equipment weight without reducing its strength, or (2) increase the size and capacity of equipment without increasing total weight or the power required to move it.

You will find our 174-page *"Design Manual for High Strength Steels"* extremely useful in applying the benefits of these steels to your product. Send for free copy—simply write on your company letterhead to United States Steel Corporation, Room 5417, 525 William Penn Place, Pittsburgh 30, Pa.

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COLUMBIA-GENEVA STEEL DIVISION, SAN FRANCISCO • NATIONAL TUBE DIVISION, PITTSBURGH
TENNESSEE COAL & IRON DIVISION, FAIRFIELD, ALA. • UNITED STATES STEEL SUPPLY DIVISION, WAREHOUSE DISTRIBUTORS
UNITED STATES STEEL EXPORT COMPANY, NEW YORK

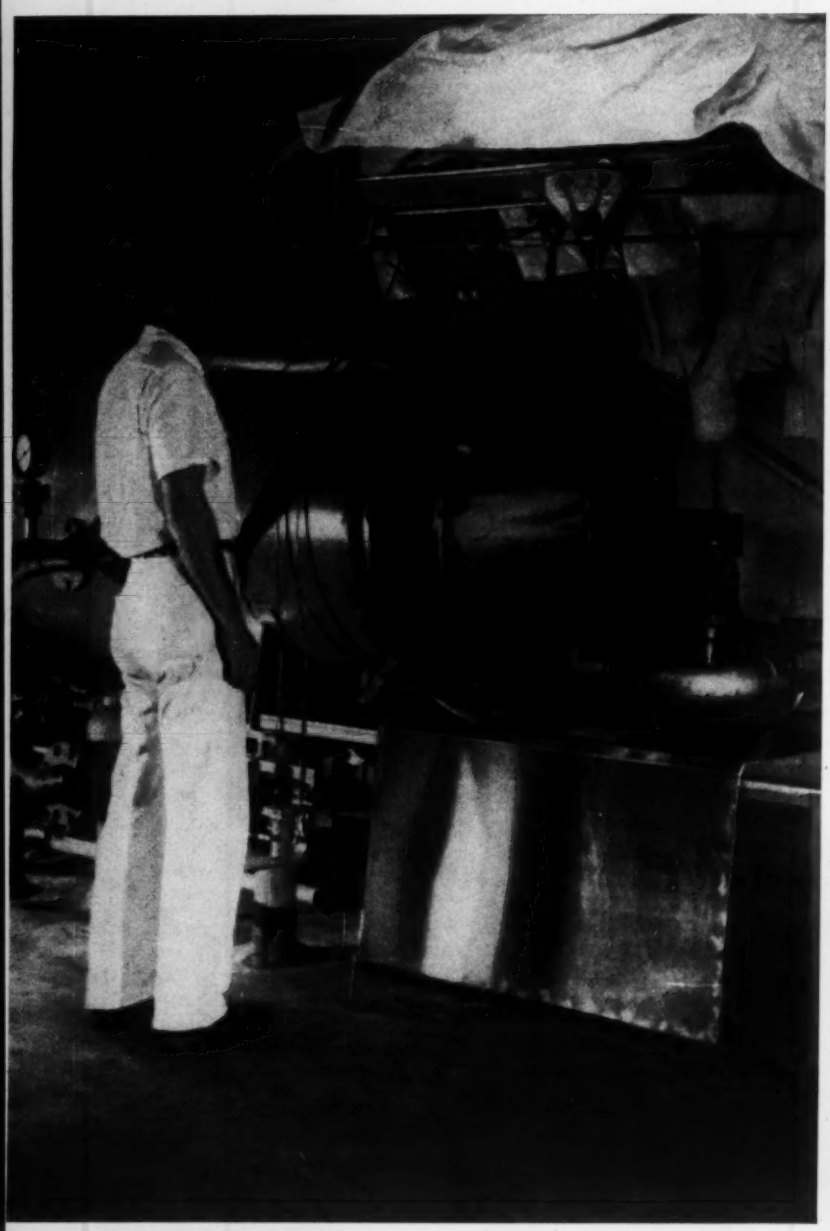
UNITED STATES STEEL USS HIGH STRENGTH STEELS TWENTY-TWO YEARS OF PERFORMANCE

USS HIGH STRENGTH STEELS

USS MAN-TEN • USS COR-TEN • USS TRI-TEN

UNITED STATES STEEL

NOTHING *can equal Stainless Steel*



FOR CORROSION RESISTANCE. The Norwich, N. Y. plant of Norwich Pharmacal Company is a magnificent display of Stainless Steel. Shown here is a Stainless Steel filter, used to separate mother liquor from the solids of furoxone. Here, Stainless outlasts any other practical metal by two to one.

FOR EASY CLEANING. In this textile plant of W. J. Dickey & Sons, Inc., dyeing time *and* costs have been cut 50% with the use of Stainless Steel equipment. When colors are changed, tanks don't have to be boiled out. With its smooth, dense surface, Stainless can be cleaned easily and quickly.

FOR CONSUMER APPEAL. Now, just about every housewife knows what Stainless Steel is. When she sees the Stainless tub in this automatic laundry, made by Speed Queen Corp., Ripon, Wis., she knows that there is nothing to corrode. She knows, too, that the Stainless tub will stay bright and clean and will last forever.

No other design material can match Stainless Steel in its *combination* of desirable properties: corrosion resistance, strength and hardness, beauty, cleanability and easy fabrication. When buying Stainless, remember that United States Steel offers the widest range of types, finishes and sizes available in the United States.

USS STAINLESS STEEL

SHEETS · STRIP · PLATES · BARS · BILLETS · PIPE · TUBES · WIRE · SPECIAL SECTIONS

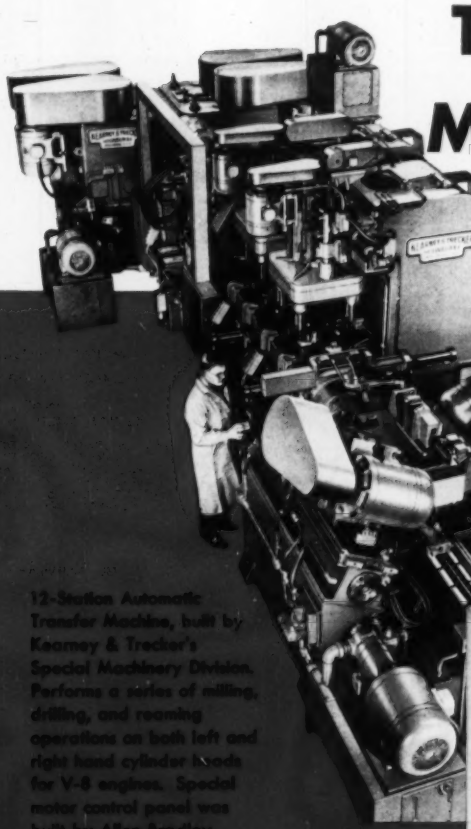
UNITED STATES STEEL

UNITED STATES STEEL CORPORATION, PITTSBURGH · AMERICAN STEEL & WIRE DIVISION, CLEVELAND · COLUMBIA-GENEVA STEEL DIVISION, SAN FRANCISCO · NATIONAL TUBE DIVISION, PITTSBURGH
TENNESSEE COAL & IRON DIVISION, FAIRFIELD, ALABAMA · UNITED STATES STEEL SUPPLY DIVISION, WAREHOUSE DISTRIBUTORS · UNITED STATES STEEL EXPORT COMPANY, NEW YORK

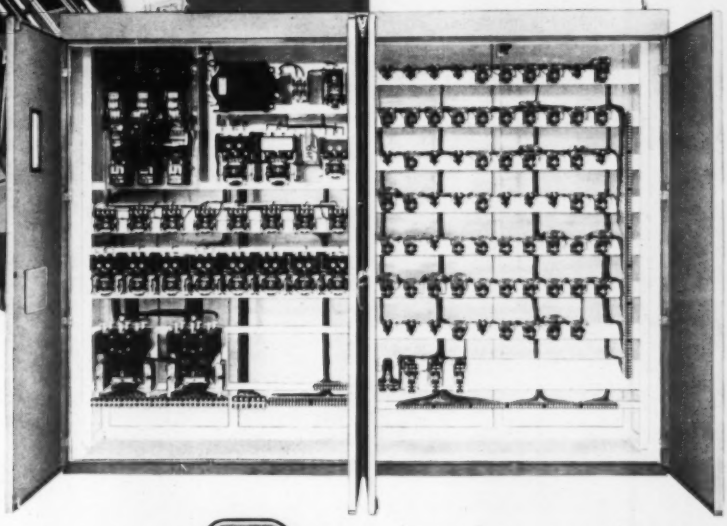
Satisfied Customers

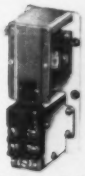
RESULT FROM THE USE OF

Trouble Free Motor Control Panels

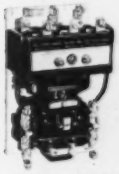


12-Station Automatic Transfer Machine, built by Kearney & Trecker's Special Machinery Division. Performs a series of milling, drilling, and reaming operations on both left and right hand cylinder heads for V-8 engines. Special motor control panel was built by Allen-Bradley.





Bulletin 849
Pneumatic Timer



Bulletin 709
Automatic Solenoid Starter

Bulletin 802T
Oiltight Limit Switch

Bulletin 800T
Oiltight Push Button

You get two definite advantages when you let Allen-Bradley furnish your special control panels, namely—trouble free, continuous reliability plus ready customer acceptance.

Allen-Bradley control panels are built from standard components whose reliability and maintenance free operation have been proven in many years of service. Their simple design is your guarantee of millions of trouble free operations. The familiar A-B trademark—recognized universally as the sign of QUALITY—is a decided sales asset on your equipment.

Write for your copy of the Allen-Bradley Handy Catalog—the quick and easy reference guide that will help you select individual control units, or components for special control panels.

A-B Quality

ALLEN-BRADLEY

MOTOR CONTROL

QUALITY

Allen-Bradley Co., 1316 S. Second St., Milwaukee 4, Wis.

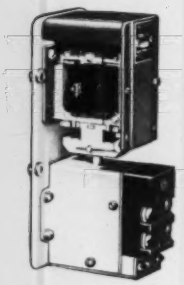
In Canada—Allen-Bradley Canada Ltd., Galt, Ont.

Bulletin 702
Solenoid Contactor

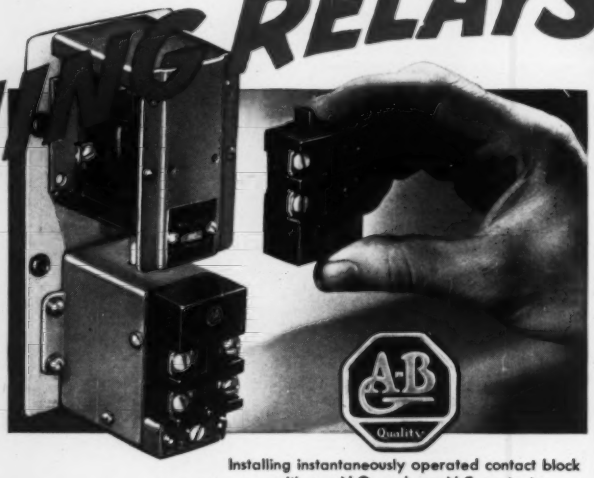
Bulletin 700
Solenoid Relay

7-56-R

TIMING RELAYS!



Bulletin 849 "On-Delay" timer. By inverting solenoid, timer is converted to "Off-Delay" operation.



Installing instantaneously operated contact block with one N.O. and one N.C. contact

Timer Adjustment

The timing interval can be adjusted quickly and easily by turning the adjusting screw.

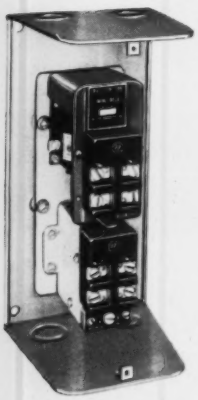
Tell Us About YOUR TIMER NEEDS . . . Allen-Bradley Has the RIGHT ANSWER!

Here is a line of pneumatic timers that can be adjusted for a consistent time delay of 1/6 second up to 3 minutes. Air, drawn into the timer through a needle valve, is freed from dirt and dust down to submicroscopic size by a high efficiency glass fiber paper filter. Thus the time settings are accurately maintained over long periods. These timers can be expected to operate reliably under conditions of severe atmospheric contamination.

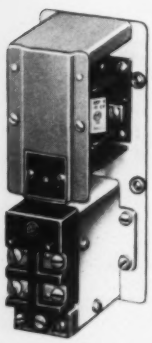
An outstanding feature of these timers is the wide variety of types available, and the modifications which can be made in the field, such as adding one or two instantaneously operated auxiliary contacts. Also, it is easy to change an "On-Delay" timer to the "Off-Delay" operation, or vice versa—by simply inverting the operating solenoid. The "On-Delay" timer provides the time delay *after* the magnetic operating COIL IS ENERGIZED; the "Off-Delay" timer provides the time delay *after* the operating COIL IS DE-ENERGIZED.

The Bulletin 849 timer has one normally open and one normally closed contact. As usual, the Allen-Bradley double break, silver alloy contacts are maintenance free. Auxiliary contacts can be mounted as shown below.

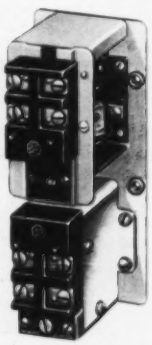
A few typical Bulletin 849 Pneumatic Timer combinations



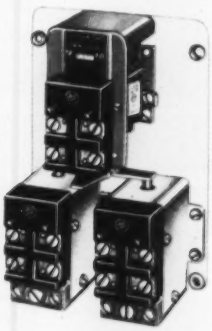
Bulletin 849 timer with one N.O. and one N.C. auxiliary contact.



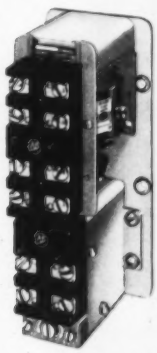
Bulletin 849 "Off-Delay" pneumatic timer with time delay *after* the coil is de-energized.



Bulletin 849 "Off-Delay" pneumatic timer with one N.O. and one N.C. auxiliary contact.



Bulletin 849 "On-Delay" pneumatic timer with two adjustable timing units.



Bulletin 849 pneumatic timer with two N.O. and two N.C. auxiliary contacts.

Allen-Bradley Co.
1316 S. Second St.
Milwaukee 4, Wis.

ALLEN-BRADLEY

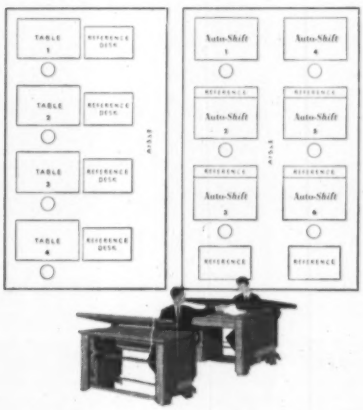
PNEUMATIC TIMERS

In Canada—
Allen-Bradley Canada Ltd.
Galt, Ont.

ONLY *LOW COST* WAY TO ENLARGE YOUR ENGINEERING DEPARTMENT

You can enlarge your engineering department in two different ways. With time-consuming, costly new construction, averaging $25-per-square-foot or $1500-per-draftsman. Or, by installing Auto-Shift drafting tables that put *more draftsmen* to work, *more productively*, in your existing space. Installed in rows, Auto-Shifts provide reference and storage space directly *behind* each draftsman (see diagram). Each 250 square feet accommodates *two more* Auto-Shifts than conventional tables and desks.

What's more, the man at the Auto-Shift gets *more work* done. Two finger-tip controls adjust board height and slope so easily that working position can be frequently changed, fatigue avoided. In installation after installation, Auto-Shift users report that increased quantity and quality of work quickly repay initial cost. Why not get all the interesting facts about Auto-Shift tables. Simply write Auto-Shift, Hamilton Manufacturing Company, Two Rivers, Wisconsin.



In about 250 square feet—4 men work at conventional tables and desks—6 men work, better and faster, at Auto-Shift tables.

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A Douglas engineer lives here

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Take that ten year ahead look. There's a fine career opportunity in the engineering field you like best waiting for you at Douglas.

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For further information about opportunities with Douglas in Santa Monica, El Segundo and Long Beach, California divisions and Tulsa, Oklahoma, write today to:

DOUGLAS AIRCRAFT COMPANY, INC.

C. C. LaVene, 3000 Ocean Park Blvd., Santa Monica, California

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COMPLETE LINE OF REGULATORS, VALVES, MIXERS, AND CONTROLS FOR LIQUIDS, AIR OR GASES.

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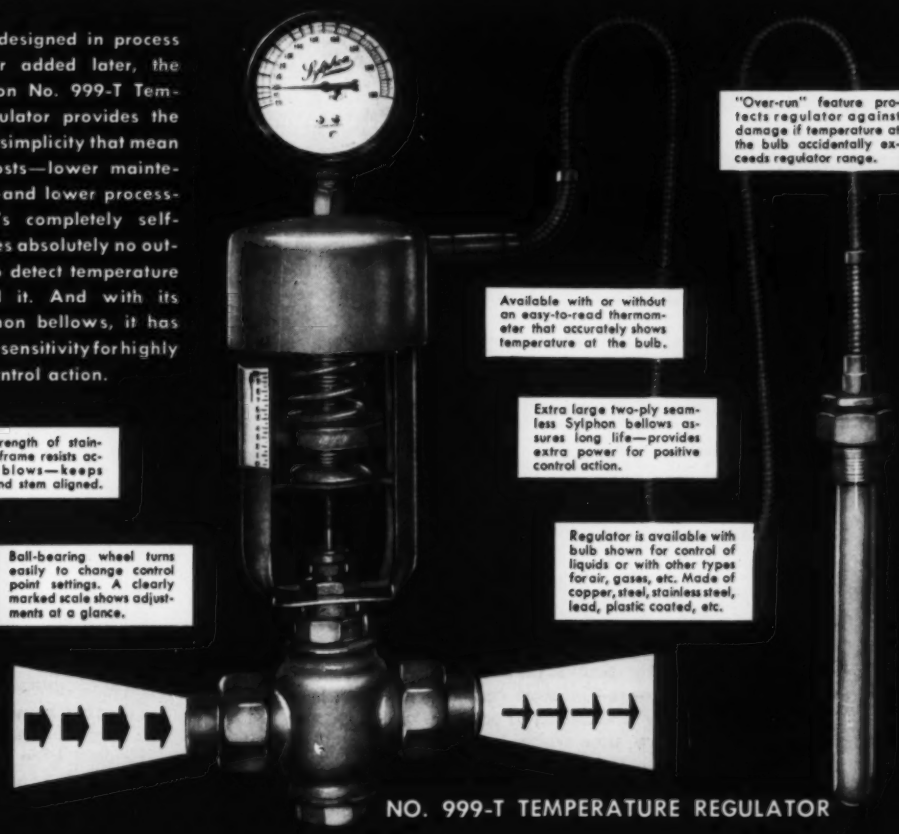
Sylphon
"Over-run" feature protects regulator against damage if temperature at the bulb accidentally exceeds regulator range.
Available with or without an easy-to-read thermometer that accurately shows temperature at the bulb.
Extra large two-ply seamless Sylphon bellows assures long life—provides extra power for positive control action.
Added strength of stainless steel frame resists accidental blows—keeps bellows and stem aligned.
Ball-bearing wheel turns easily to change control point settings. A clearly marked scale shows adjustments at a glance.
Regulator is available with bulb shown for control of liquids or with other types for air, gases, etc. Made of copper, steel, stainless steel, lead, plastic coated, etc.

NO. 999-T TEMPERATURE REGULATOR

Available with 60 F ranges between 20 and 455 F.
Variety of valve types in sizes from ¼" to 4".

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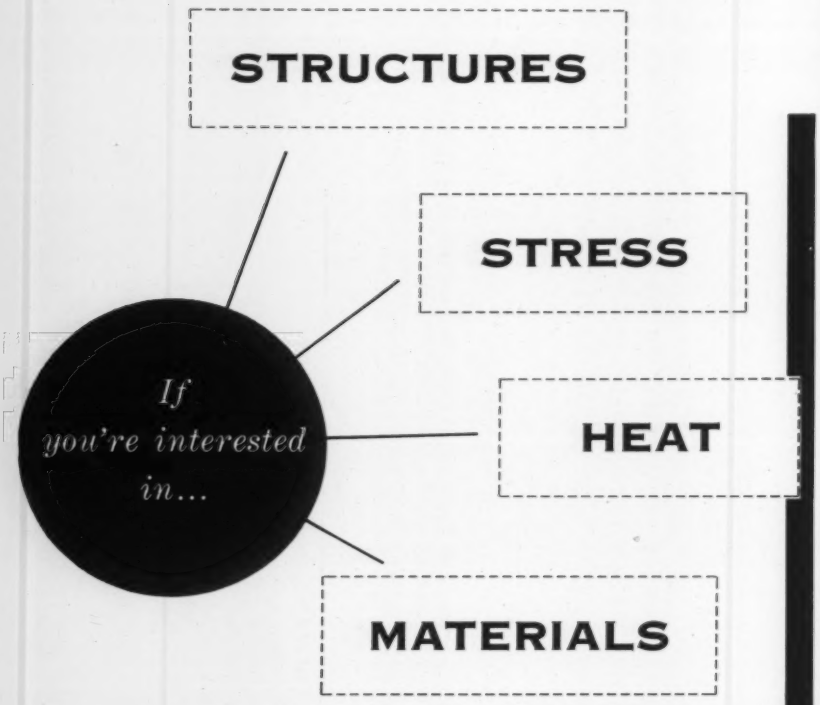

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There are many excellent openings for mechanical and aeronautical engineers for challenging assignments in the areas of high-speed missiles, aircraft structures, and antennas. This work concerns developing practical solutions to both theoretical and actual problems of heat transfer, structural analysis and design, stress analysis, materials section, and instrumentation.

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HUGHES

Research and Development Laboratories
HUGHES AIRCRAFT COMPANY
Culver City
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For the analysis and design of missile structures and other airborne equipment. Also adhesives engineers, metallurgical and materials engineers with aircraft or missile design experience.

MECHANICAL ENGINEERS
To participate in the design and development of missiles, missile launchers, aircraft structure, component installation, environmental test equipment and general mechanical design.

AERONAUTICAL ENGINEERS
For the analysis and design of missile launching equipment for high-speed aircraft, including coordination and liaison with many major airframe manufacturers.

DYNAMICS ENGINEERS
To work on shock and vibration problems in an aerothermal environment. Also elasticians to work on advanced aerothermoelastic problems associated with high-speed flight.

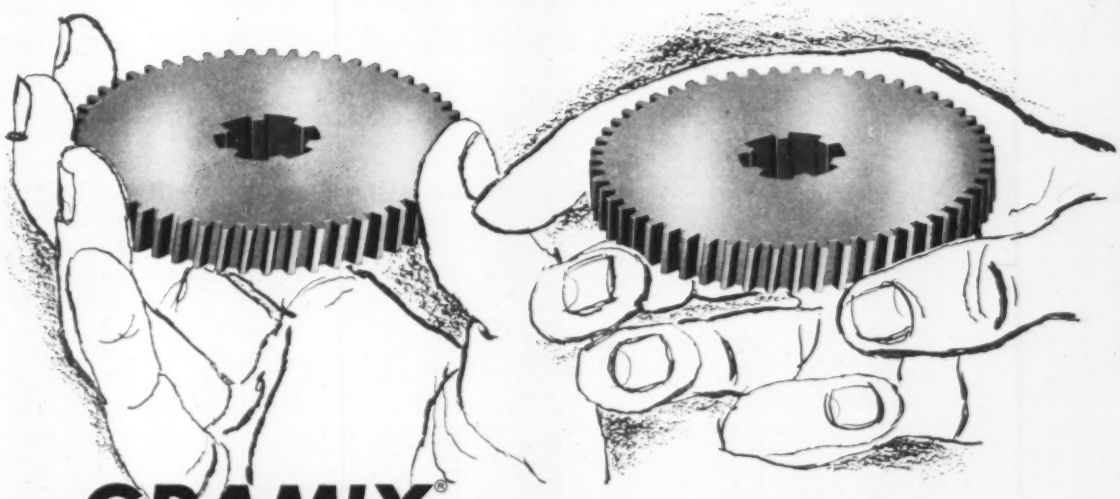
ENGINEER
For research related to the selection of materials and development of fabrication techniques.

LIAISON ENGINEER
To work between Development Laboratories in Culver City and Engineering Laboratory in Tucson or between the Laboratory and subcontractors.

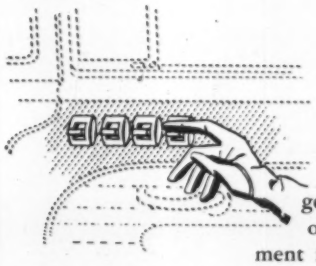
THERMODYNAMICIST
To perform analytical and experimental analysis of heat transfer from electronic components via natural convection, forced-air convection, and radiation.

These positions also available in the Research and Development activity at Tucson, Arizona.

which helical gear costs 80% less?



the GRAMIX® sintered metal helical gear performs better than a forged and hobbed aluminum part for just 1/5 the cost!



By replacing forged aluminum gears with sintered steel GRAMIX helical gears, a manufacturer of automotive equipment found that he could realize an 80% saving and get greater dependability. The gear is a component of an automatic window raising and lowering mechanism currently being used by four different automobile manufacturers. The helical teeth are formed in the compacting dies, and, after sintering, the GRAMIX gear is ready for assembly into the power window unit . . . there is no need for costly machining or time-consuming finishing operations like the hobbed aluminum gear used previously. In spite of the astonishing savings, these GRAMIX gears have proven to be even better than the former forged gear from a standpoint of toughness and wearability.

114

GRAMIX metallurgists can provide the exact alloy for your design specifications. GRAMIX parts may be oil-impregnated for self-lubrication. They seldom need machining, and will often outlast similar machined parts. Complex shapes can be produced to tolerances as close as .0005". Whatever your requirements may be, it will pay you to investigate GRAMIX.

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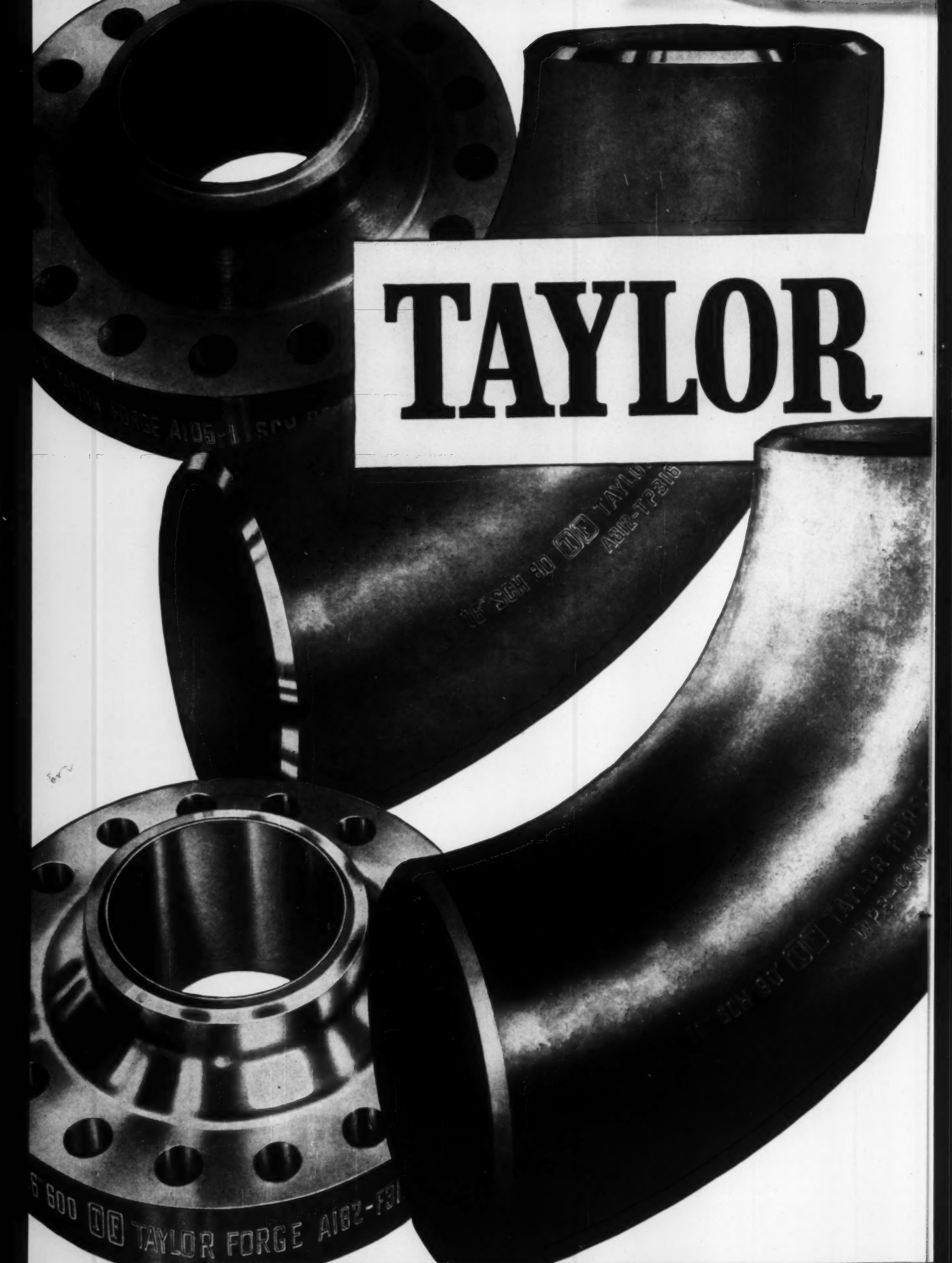
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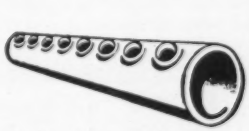
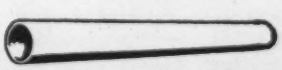


Multiple outlet headers

Production forgings

Venturi reducers

Spiral weld pipe

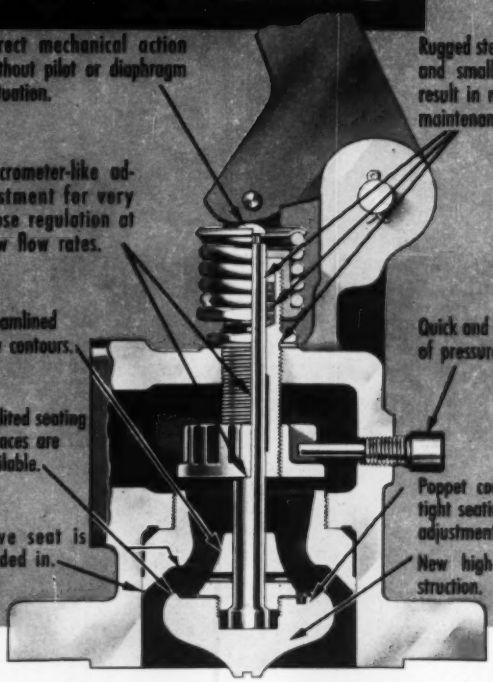


Large diameter electric weld pipe

Welding necks

POPPET TYPE VALVES

An IMPORTANT REASON for the better performance of these DIAMOND Blowers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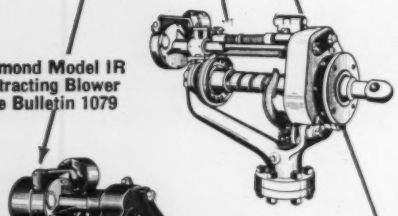
Rugged stem, proper guiding and small packing surface result in minimum maintenance.
Micrometer-like adjustment for very close regulation at low flow rates.
Streamlined flow contours.
Quick and simple adjustment of pressure control.
Stellited seating surfaces are available.
Poppet construction assures tight seating without critical adjustment.
Valve seat is welded in.
New high-flow valve construction.

Note carefully the important advantages pointed out on the illustration above. You will see why Diamond Poppet Type has proved its superiority by many years of successful operation on the most difficult jobs.

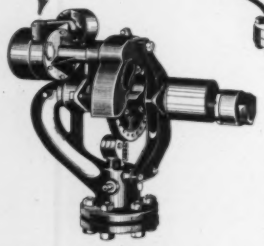
The integral adjustable pressure control device is used when boiler or header pressure is higher than desirable for blowing. Its location outside the path of valve travel permits full and immediate opening of the poppet valve, thus avoiding wire drawing.

The valve readily lends itself to examination and repair. Disc and seat are quickly accessible, and regrinding can be done quickly without dismounting the head. Seat and disc are forged and the stem rolled from stainless steel.

This valve construction is one of the many reasons why Diamond Blowers give better boiler cleaning at lower cost.



Diamond Model IR
Retracting Blower
See Bulletin 1079



Diamond Model G9B
Automatic Valve Blower
See Bulletin 1137A

Diamond Model IK
Long Retracting Blower
See Bulletin 1080A

DIAMOND POWER SPECIALTY CORP.
LANCASTER, OHIO
Diamond Specialty Limited, Windsor, Ontario

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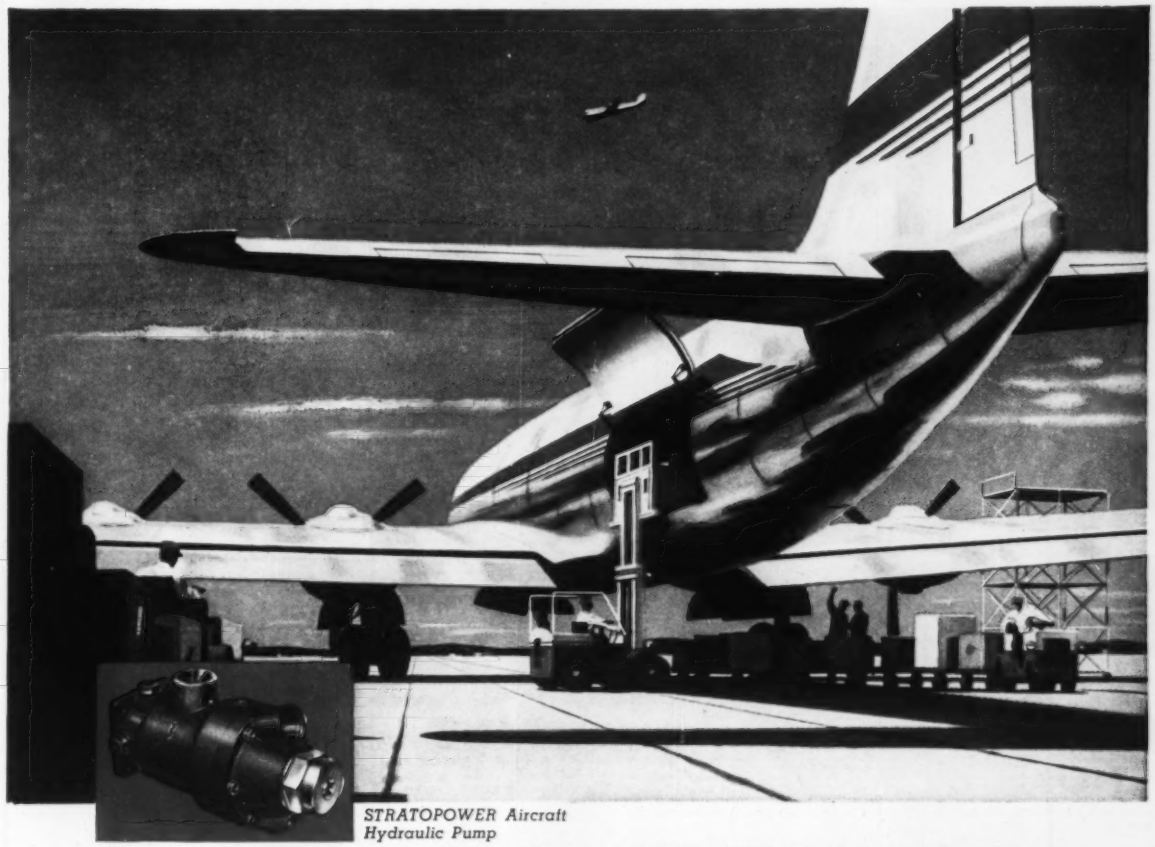

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Forces are so great and response requirements so exacting at today's air speeds that no man is strong enough or quick enough to adjust controls for even the simplest maneuver. Yet, a STRATOPOWER Hydraulic Pump, smaller than a football, provides Fluid Power that enables a pilot, with no more than a "fingertip flip," to perform, precisely and instantly, a dozen jobs. Among these are: raising and lowering landing gear, operating control surfaces or wing flaps. And, STRATOPOWER Pumps with their amazing weight/horsepower ratio perform many other supplementary chores in the air such as: powering air conditioning and pressurizing equipment, radar scanners and other jobs that Fluid Power does better.

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In addition to two Divisions specializing in Power Hydraulics, there is valuable "know-how" in Liquid Handling at Aurora Pump and Kinney Mfg. Divisions plus intimate knowledge of Vacuum Processing in the Kinney Mfg. Division.

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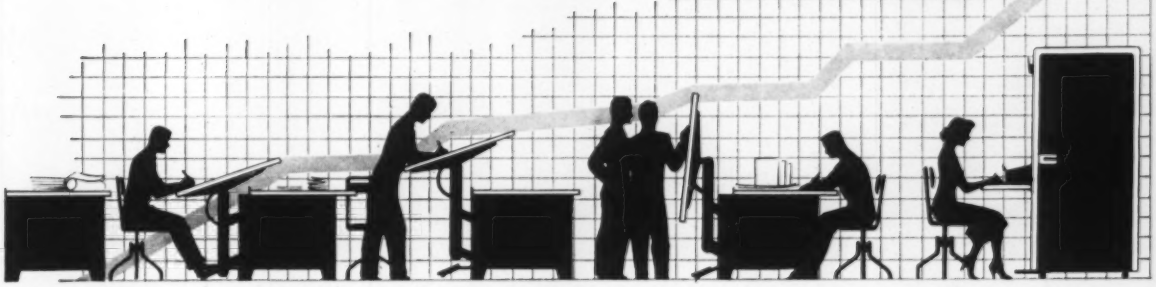

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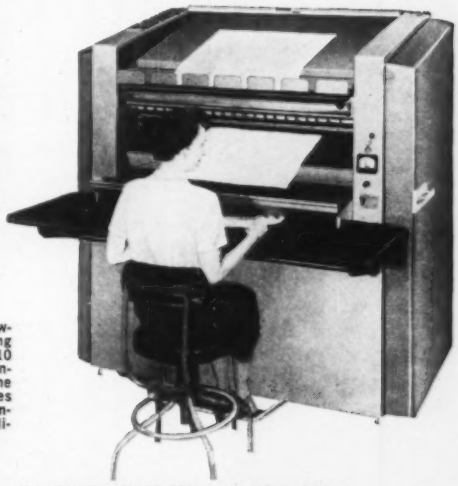
Two Great New Models for the Large Or Small Engineering Department!

If your company, like most others, is gearing up for greater-than-ever production, it will mean more pressure on your drafting room for engineering drawings and prints. You couldn't pick a better time to get a new modern reproduction machine. And you couldn't make a wiser choice than efficient, trouble-free Copyflex.

In just the last year, Bruning has introduced five new advanced machine models, two of which are shown here. These machines cover the reproduction needs of engineering departments, from the smallest to the largest. They offer you the famous problem-free installation and operation of Copyflex . . . no exhaust venting, no plumbing or auxiliary equipment, no installation other than an electrical connection. They bring you faster reproduction and a host of operator conveniences that will help you boost drafting room output, keep costs at a minimum.

Now is the time to act. Mail the coupon below. You will be glad you did.

New Copyflex Model 300. An all-new, low-cost tabletop model offering 30-inch printing width, up to 9 f.p.m. mechanical speed, 110 volt operation. Brings the advantages of "inside" reproduction within the reach of the smallest engineering department. Enables the largest company to supplement, economically, its reproduction center with additional, strategically located model 300's.



New Copyflex Model 500. A new, fast, heavy-volume machine offering top mechanical speed of 40 f.p.m., 46-inch printing width, automatic separation, front or rear delivery, automatic stacking, and a host of other advanced features.

BRUNING Copyflex

Best Process! Best Machines! Best Selection of Materials!

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Please send me information on Copyflex process and
☐ Model 500 ☐ Model 300.

Name_____ Title_____

Company_____

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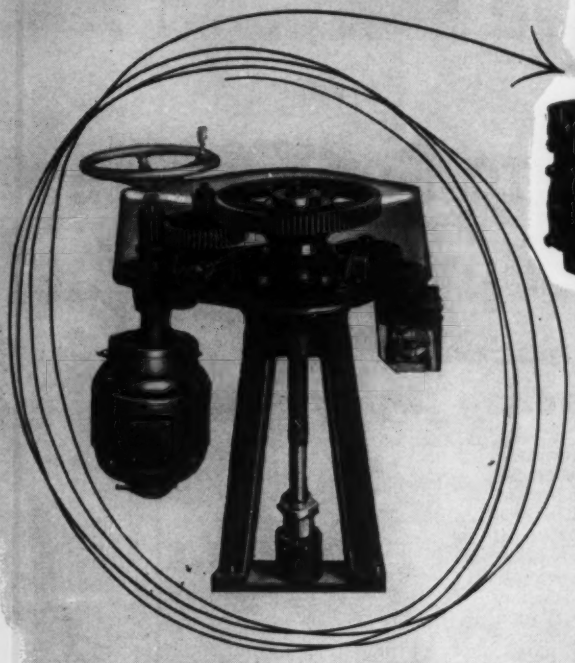
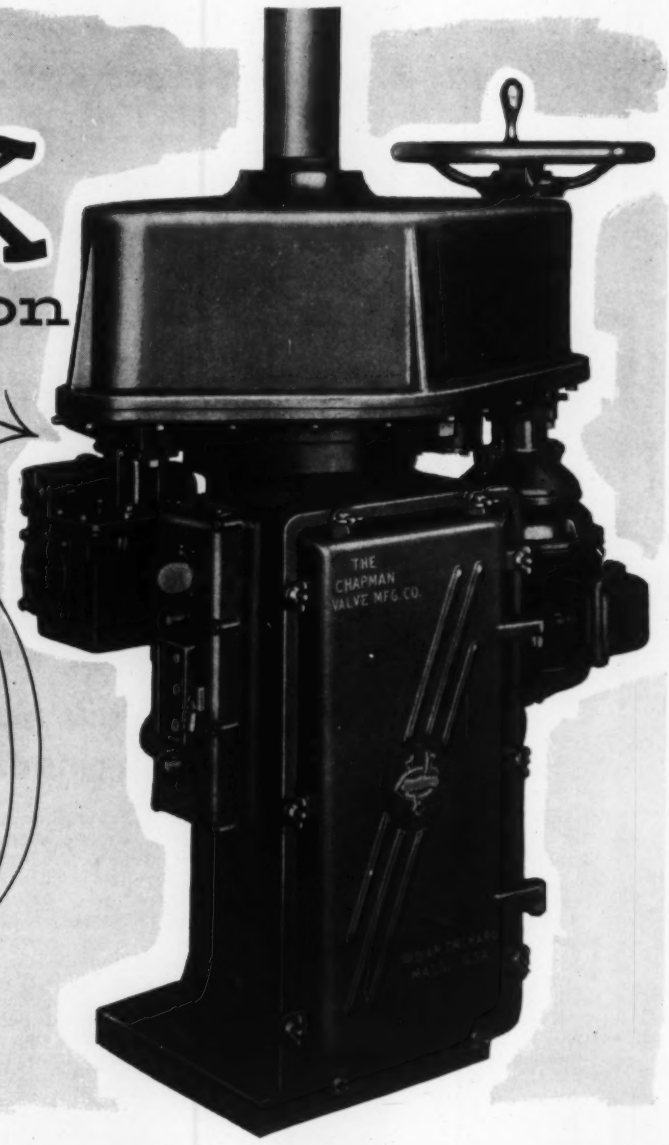
In the PINK of Condition





CHAPMAN MOTOR UNITS

We've done one thing for you. Chapman's Motor Units . . . for operation of valves, floorstands and sluice gates . . . are in the best of condition for accurate performance and longer, lower cost life.

We've made them as you like them . . . simplified them . . . streamlined them . . . taken off all the fat. In fact, when you look at a Chapman Motor Unit today, you can only find approximately *half as many parts* as on any other unit.

This simplicity, combined with Chapman's traditional ruggedness, means less trouble and lower maintenance over a longer period of smooth, accurate performance.

How can you go wrong? With Chapman Motor Units, the simplified design . . . the sturdy construction . . . mean no drift; less slash, accurate micrometer-controlled limit switch for predetermined seat tightness; quiet motor driven operation at all *times*. All at the lowest overall cost.

No trouble with operating positions. Operation is assured at any angle. Rugged stub-tooth gears need no grease or oil. No trouble with operating conditions. All units are weatherproof . . . *steam tight*. No trouble even with installations. When used with floorstands they are completely wired at the factory . . . ready to connect with your leads. Easy and simple to install.

Get our new catalog . . . Catalog 51 . . . on Chapman motor units today.

The Chapman Valve Manufacturing Co.
INDIAN ORCHARD, MASSACHUSETTS

MODERN OIL AND GAS FIRED BOILERS

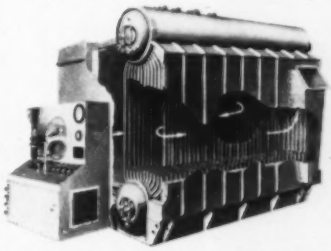
The boilers illustrated here cover the broad capacity range from 4,000 to 600,000 lb of steam per hr. They are all especially designed for gas and/or oil firing. The two units illustrated at right (Types VP and VU-55) are standardized and each is available in several sizes. The capacity range covered by these two units is from 4,000 to 120,000 lb per hr. The two units below are custom designed for various capacity, pressure and temperature requirements up to 600,000 lb per hr, 1400 psi and 950 F. All these units are pressure fired and do not require induced draft fans.

Collectively, they offer an exceptional diversity of choice. A brief consideration of the features of each type will help you "pinpoint" the design characteristics best suited to your particular needs.

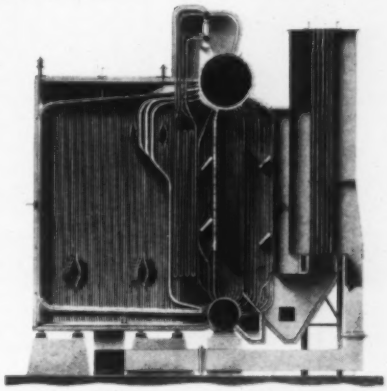
Of course there are other C-E two drum Vertical-Unit Boilers available for pressures up to 1400 psi and temperatures up to 960 F. Shown here are but four popular members of the C-E family of Vertical-Unit Boilers—a family which has achieved a wide measure of acceptance using all types of fuel.

Please feel free to call on us for further detailed information. Catalogs are available upon request.

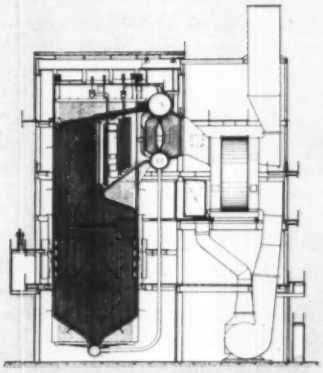
B-922-A



C-E Package Boiler — Type VP Completely shop assembled . . . available in fourteen sizes from 4,000 to 40,000 lb capacity . . . pressures to 500 psi. Available with integral console control panel, this unit contains more water-cooled area per cubic foot of furnace volume than any other boiler of its size and type. It can be equipped with any of several approved burners.

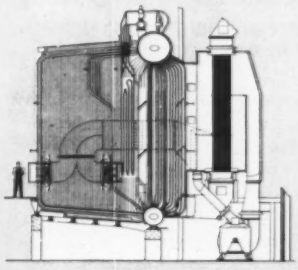


C-E Vertical Unit Boiler — Type VU-55 Available in six sizes . . . capacities from 50,000 to 120,000 lb steam per hour . . . designed for two pressure ranges, 250 psi and 500 psi, and total steam temperatures up to 750 F. This double cased, gas-tight unit is equipped with tangential burners. A large (60-inch) steam drum assures generous water capacity and steam reservoir space. Tangent tube waterwalls offer complete furnace protection, minimizing maintenance.



C-E Vertical Unit Boiler — Type V2

This unit is available for capacities from 200,000 to 600,000 lb per hr. It can be designed for pressures up to 1400 psi and for temperatures to 950 F. Tilting tangential burners, providing superheat control, are standard equipment although horizontal burners are available, if desired. A double, gas-tight casing assures lifetime tightness and minimum heat loss. Heat recovery equipment can be furnished as desired.



C-E Vertical Unit Boiler — Type VU-50B

This unit is available for capacities from 50,000 to 400,000 lb per hr—pressures to 1400 psi and temperatures to 950 F. This bottom-supported design uses tilting tangential burners providing effective superheat control. Horizontal burners can be furnished if desired. Heat recovery equipment as required. This unit makes available to industrial installations a standard of performance comparable to utility practice.

COMBUSTION ENGINEERING

Combustion Engineering Building

200 Madison Avenue, New York 16, N. Y.

STEAM GENERATING UNITS · NUCLEAR REACTORS · PAPER MILL EQUIPMENT · PULVERIZERS · FLASH DRYING SYSTEMS · PRESSURE VESSELS · HOME HEATING AND COOLING UNITS · DOMESTIC WATER HEATERS · SOIL PIPE

"If you had asked me that question three months ago..."

"—I would have been ashamed to answer you. But today, I'm glad to say, we have a good Payroll Savings Plan—with 84.4% of our employees enrolled.

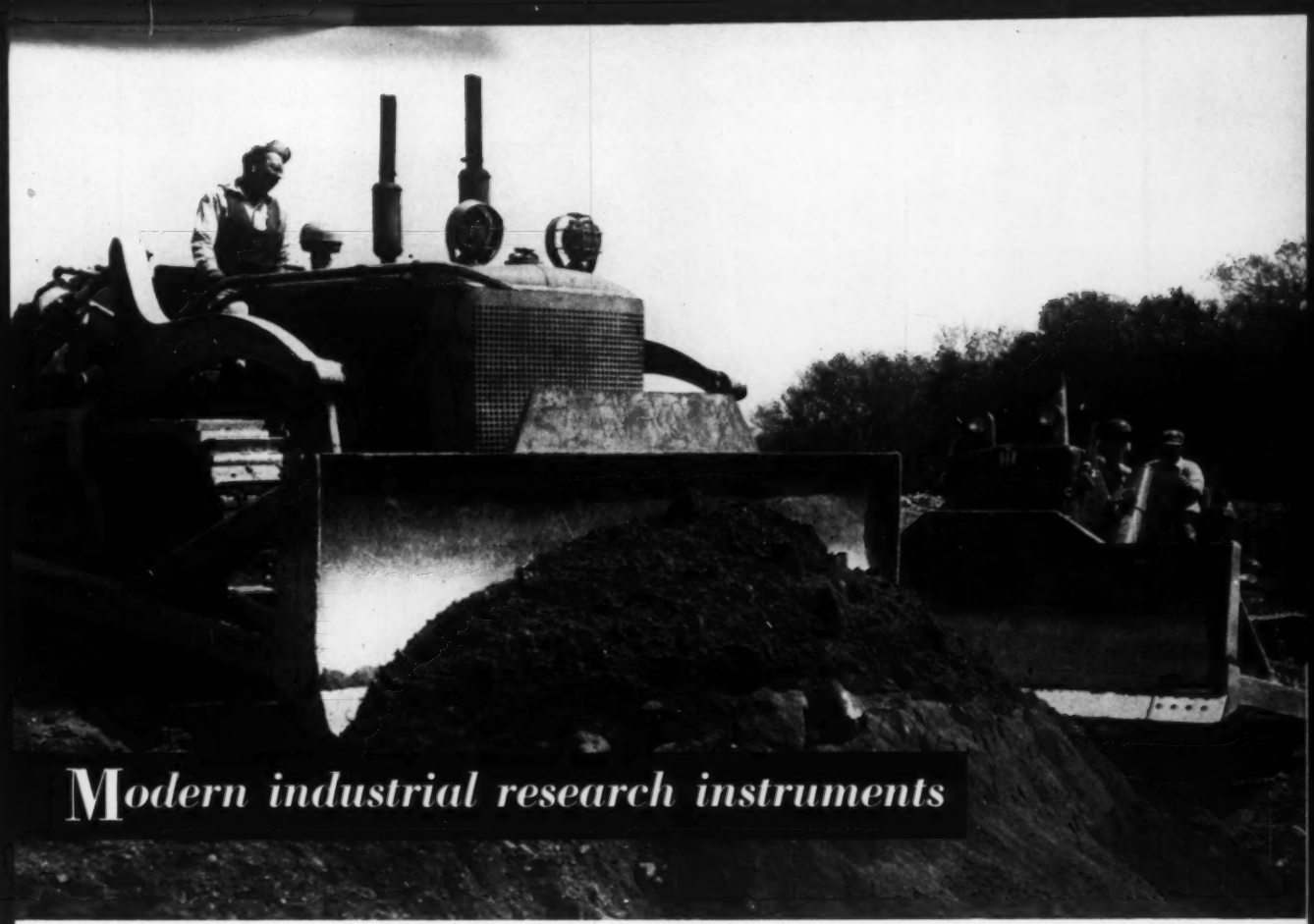
"Of course, we've always had The Plan—put it in during the war—but with changes in personnel and our failure to present the Plan to new employees, participation dropped to almost nothing.

"One day our State Director of the Savings Bond Division, U. S. Treasury Department, dropped in to see me. When he told me how far below average we were I asked him what we could do to bring it up. He gave me a complete campaign built around a person-to-person canvass that would put a Payroll Savings Application Blank in the hands of every employee, with the Treasury furnishing pay-envelope stuffers, posters and other literature. I was a little dubious about the personal canvass but our employees were enthusiastic, in fact, officials of our union volunteered to undertake the canvass. There was no pressure, no teams, no prizes—just the distribution of the Application Blanks. Our employees did the rest—84.5% enrollment.

"84.5% is a good enrollment but we are not going to rest on it. A number of companies are in the 90% bracket—that's our goal."

Your State Director, Savings Bond Division, U. S. Treasury Department, will be glad to help you install The Payroll Savings Plan, or build participation in an existing plan. Write: Savings Bond Division, U.S. Treasury Department, Washington 25, D. C.

The United States Government does not pay for this advertising. The Treasury Department thanks, for their patriotic donation, the Advertising Council and



Modern industrial research instruments

THESE seven-ton bulldozers are truly research tools, for they are taking part in an exhaustive program for the study and revision of accepted methods of oscillographic recording system design and manufacture.

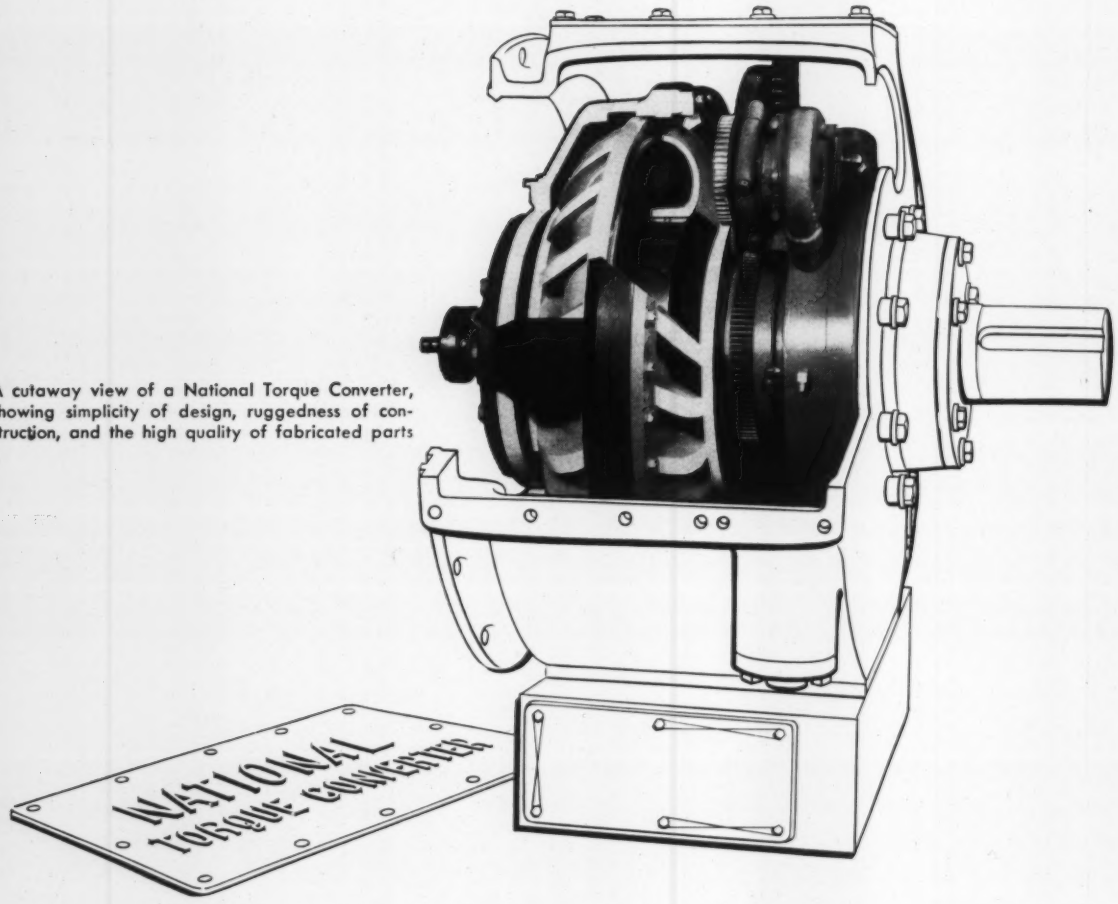
Yes, Sanborn Company is on the move! The instruments above are levelling off small mountains of earth and rock in preparation for a new and modern Sanborn plant near Boston, Mass.

Completion of the structure late this year will mean vastly improved facilities for research, manufacturing and other operations. This will directly and immediately benefit not only the work Sanborn does, but also the people who use Sanborn systems, amplifiers, recorders and other components. It will make possible more rapid development and production of new instruments, and increased opportunity for a larger number of people to apply their skills to the problems of modern instrument design and manufacture.

This represents not "just a new plant", but a reflection of Sanborn's growing role in providing better answers to industry's oscillographic recording needs.

Sanborn Company, Industrial Division, Cambridge 39, Massachusetts

Scale model of new Sanborn plant just off Route 128 in Waltham, Mass.



A cutaway view of a National Torque Converter, showing simplicity of design, ruggedness of construction, and the high quality of fabricated parts

It's rugged...it's durable...it's dependable...

it's a NATIONAL Torque Converter

The simple, rugged design of National Torque Converters offers many unique features.

Converter is easy to install.

Equipment service life is prolonged.

Maintenance of equipment and torque converter is at a minimum, even in the roughest, toughest industrial service.

Meets the most rugged demands of practically every heavy-duty application—oil drilling rigs, excavating, earth-handling, mining, logging and similar equipment.

In addition, precision fabrication provides uniform high efficiency permitting standardization of National Torque Converter on your equipment with assurance of uniform top performance.

And you have a choice of 6 basic hydraulic circuit sizes, each with a range of input ratings, to permit *exact matching* of torque converter to engines of 100 to 1000 horsepower.

National engineers will gladly work with your designers to arrive at the correct size and capacity of National Torque Converter for the specific power-speed characteristics of your equipment. Why not call on us today?

A copy of Bulletin No. 468, descriptive of National Torque Converters, is available on request.

THE NATIONAL SUPPLY COMPANY

INDUSTRIAL PRODUCTS DIVISION

Two Gateway Center, Pittsburgh 22, Pa.

Pace-setters in the progress of industrial power transmission

Remember — the trade marks "tt" and "TUBE-TURN" are applicable only to products of TUBE TURNS.

You get extra strength with *The Leading Brand*

TUBE-TURN* WELDING TEES are drawn from seamless tubing to a barrel shape. This, and other design features produce high strength—averaging over 25% more than required by applicable standards.

Specify TUBE-TURN Welding Fittings and Flanges for extra values: superior products, the exact fitting or flange you need from our complete line, outstanding engineering service. Call your nearby Tube Turns' Distributor. He is at your service!

The Leading Manufacturer of Welding Fittings and Flanges

TUBE TURNS LOUISVILLE 1, KENTUCKY

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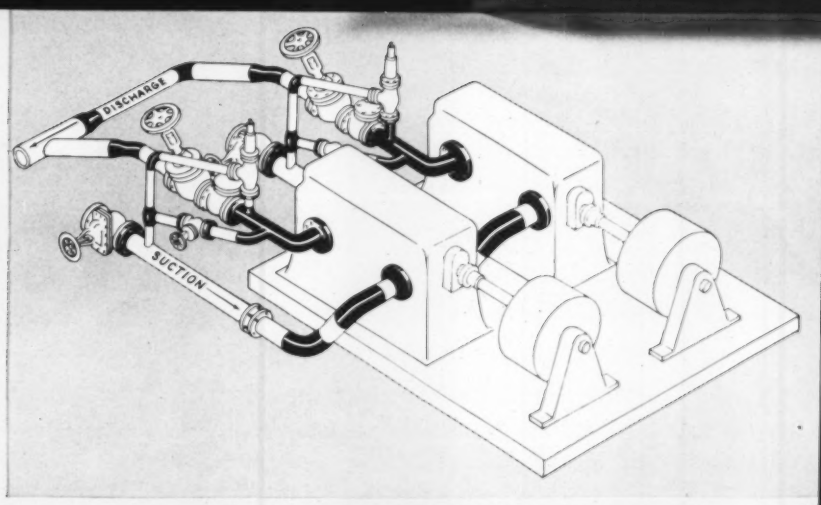
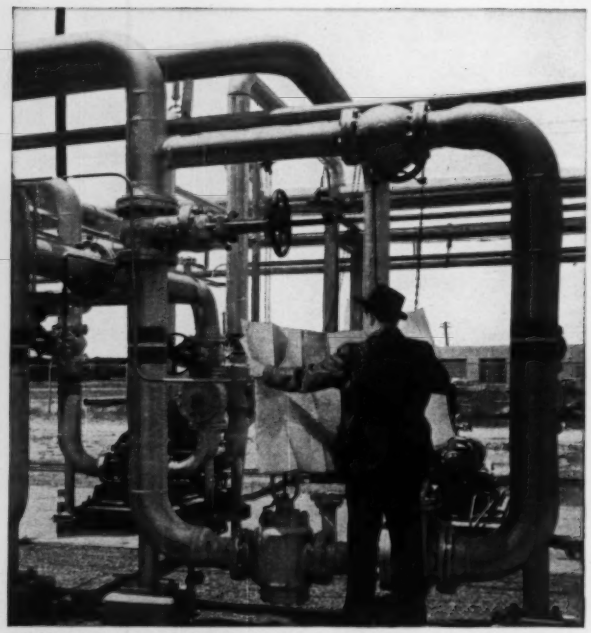
EXTRA VALUES

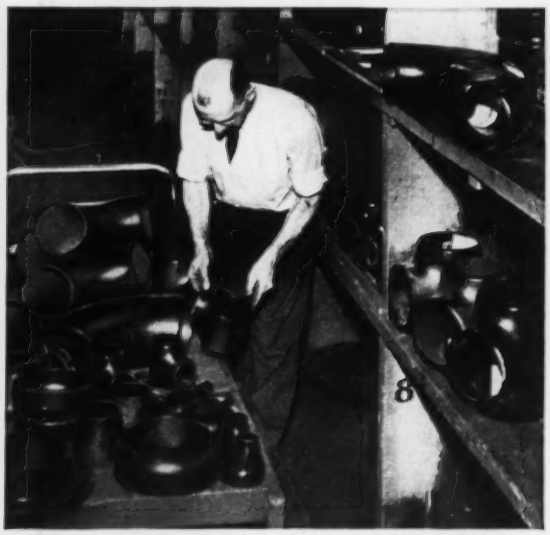
Speed up your piping jobs with TUBE TURNS' SERVICE



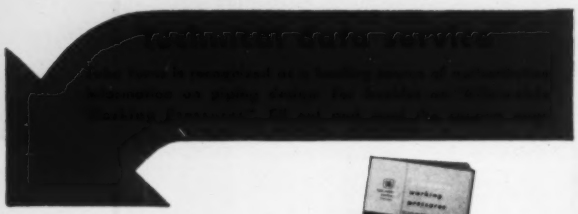
ENGINEERING SERVICE—Tube Turns' Engineering Service can help you on your piping projects. For example: Diagram above shows an application where TUBE-TURN* Welding Fittings and Flanges simplified the design and erection of pump piping. They save time, save space, and make the piping permanently leakproof and reliable. Ask your Tube Turns' Distributor to give you the pump piping recommendations of Engineering Service.



COMPLETE LINE SERVICE—You can *make sure* of getting the right fitting for each job when you specify "TUBE-TURN". This is the world's most complete line of welding fittings and flanges, including more than 4000 items, in all piping materials, schedules, and sizes.



AVAILABILITY—Your nearby Tube Turns' Distributor carries local stocks for fast delivery. Call him for good service in good connections.



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224 East Broadway, Louisville 1, Kentucky

Please send free copy of "Allowable Working Pressures"

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* "tt" and "TUBE-TURN" Reg. U.S. Pat. Off.

TUBE TURNS

A DIVISION OF NATIONAL CYLINDER GAS COMPANY

LOUISVILLE 1, KENTUCKY

Which one will qualify as a missile engineer?

All—or none—depending on three important points! The desire for a *real* engineering challenge. The ability to work with a top team of experts in their respective fields. The capacity to take on individual responsibility.

If this sounds like a lot, it's because North American Aviation has a lot to offer. With research, development and manufacturing responsibility for the U. S. Air Force SM-64 Navaho Intercontinental Missile, the scope of the art at North American is wide and the opportunity to assume a position of authority great. In fact, all phases of this project—research, design, development and testing—are being accomplished by North American engineers.

And what benefits will you find in this type of engineering environment?

First of all—recognition that comes from the opportunity for individual effort. You will work with engineers who respect your opinions and professional status. Because missile engineering covers so many fields, you can work in the area of your choice. You will work on a team of specialists whose leadership in their fields will further you in the one you choose. You will live in Southern California and receive financial compensation limited only by your own ability.

If you have the desire for a real engineering challenge—Investigate Now.

Contact: Mr. M. Brunetti, Missile Engineering Personnel
Dept. 91-9 ME, 12214 Lakewood Boulevard, Downey, Calif.

NORTH AMERICAN AVIATION, INC.

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In work as demanding as aircraft engine development, there is tremendous challenge. Skills mature fast. Men of ability are soon recognized, encouraged and rewarded.

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If you are interested in a better future, mail the coupon *today*. If more convenient, send us a letter with the required information. Be sure to include your home telephone number.

Mr. E. M. Peterson, Dept. 8, Design Employment
Pratt & Whitney Aircraft, East Hartford, Conn.

I would like to learn more about your openings for product and component designers. My experience has been in the following fields:

☐ Nuclear Design	☐ Aerodynamics	☐ Bearings
☐ Compressors	☐ Hydraulics	☐ Piping
☐ Turbines	☐ Gears	☐ Controls
☐ Structures	☐ Valves	☐ Test Equipment
☐ Afterburners and Related Equipment	☐ Heat Exchangers and Combustion Problems	☐ Test Rigs

Total years Mechanical Design experience.....

You can reach me at..... Most convenient (home telephone) hours for receiving calls are between.....and .....

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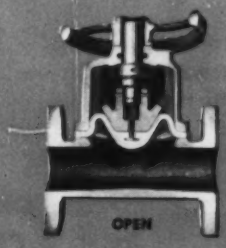
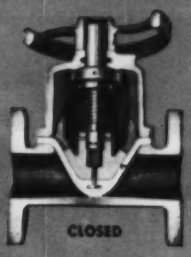
Flow Characteristics
similar to gate valves

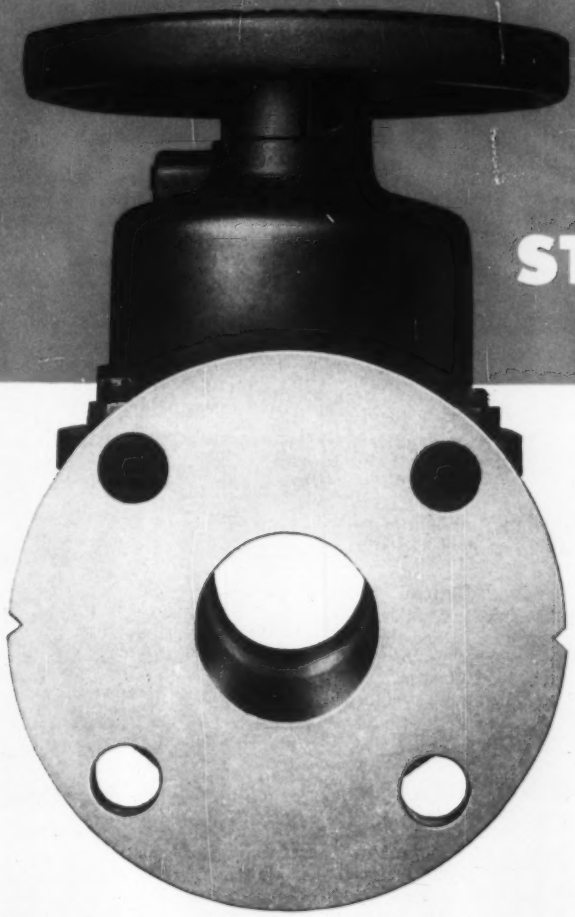
- Streamlined straight-through flow
- Minimum pressure drop
- Handles viscous materials without stoppage
- May be rodded or brushed



Advantages
of a diaphragm valve

- Positive closure even with gritty or fibrous materials
- No pockets to trap sludge
- Bonnet mechanism completely isolated from fluid in line
- Completely self-draining
- Simple maintenance





GRINNELL-SAUNDERS STRAIGHTWAY DIAPHRAGM VALVE

For handling viscous materials, slurries, sludges, solids in suspension, sewage and corrosive chemicals, Grinnell now offers a valve which has all the advantages of a diaphragm valve with the added benefits of straight-through flow.

The Straightway Diaphragm Valve* is made in sizes from ½" to 8", screwed or flanged ends, either hand wheel or power operated.

A variety of body, lining and diaphragm materials are available to meet practically all requirements. Descriptive folder gives all details.

*Patented

GRINNELL COMPANY, INC., PROVIDENCE, RHODE ISLAND
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pipe and tube fittings • welding fittings • engineered pipe hangers and supports • Thermolier unit heaters • valves Grinnell-Saunders diaphragm valves • pipe • prefabricated piping plumbing and heating specialties • water works supplies • industrial supplies Grinnell automatic sprinkler fire protection systems • Amco air conditioning systems

GRINNELL COMPANY, INC.
254 West Exchange St., Providence, R. I.

Kindly send me a copy of bulletin describing Grinnell-Saunders Straightway Diaphragm Valves.

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Address_____
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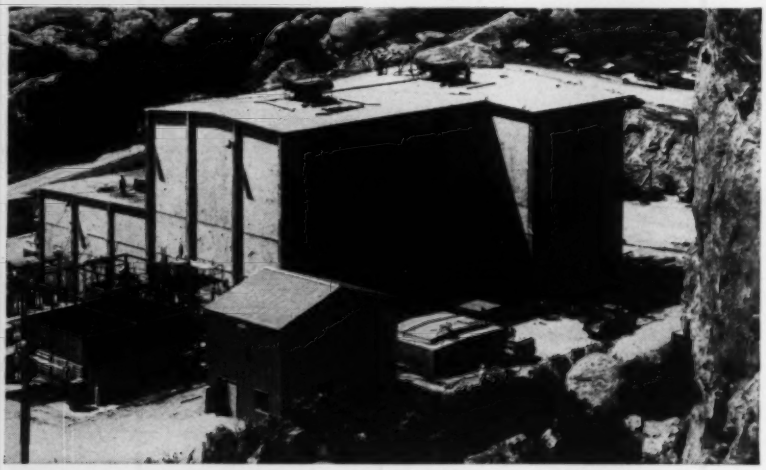
NUCLEAR NEWS FROM ATOMICS INTERNATIONAL

Nuclear reactors now being built for science and industry—for power and radiation

Within a single decade ATOMICS INTERNATIONAL engineers and scientists have developed a broad range of experience in the nuclear field through the design, construction and operation of a wide variety of reactors. This work includes four reactors completed and now in operation; four more reactors now in construction; and seven major engineering design projects completed.



Sodium Reactor Experiment nears completion in Santa Susana Mountains. It is being built and will be operated by Atomics International as a key part of AEC's nuclear power development program.

ATOMICS INTERNATIONAL, a division of North American Aviation, Inc., is a leader in the development of advanced reactor technology. A new power reactor concept, the Organic Moderated Reactor Experiment, is scheduled to be built by ATOMICS INTERNATIONAL for the Atomic Energy Commission at the National Reactor Testing Station in Idaho. This promising experiment will use an organic material—a carbon-hydrogen compound—in the dual role of moderator and coolant.

The diversified nuclear program at ATOMICS INTERNATIONAL includes:

1. Sodium Reactor Experiment. Located in Santa Susana Mountains, near Los Angeles. Fuel: either slightly enriched Uranium, or Thorium and U-233. Output: 20 Thermal Mw. Though experimental, the reactor will be equipped with heat exchanger and turbogenerator by Southern California Edison, who will feed 6.5 Mw of electric power to the surrounding area.

2. Full-scale Sodium Graphite Reactor Design. Fuel: same as above. Heat output: in the order of 250 Thermal Mw. Power Output: Uranium—75 Mw; Thorium—100 Mw; Thorium (after further development)—125 Mw. Capital costs, with full generating equipment, around $300 per Kw with Uranium, expected to be reduced with Thorium eventually to $200 per Kw. Power costs would thus decrease from 11.1 mills/kwh to 6.5 mills/kwh.

3. Water Boiler Research Reactor. Designed and built by ATOMICS INTERNATIONAL for use on Atomic Energy Commission research projects. Fuel: enriched Uranium. Power 5 watts. Flux: 10^8n/cm^2/sec (thermal). Experimental facilities include exposure holes, through-tube and vertical thermal column.

4. Livermore Research Reactor. For Atomic Energy Commission's laboratories at Livermore, Calif. A higher power version of the Water Boiler Research Reactor designed to operate at 500 W. These were the first two reactors in California.

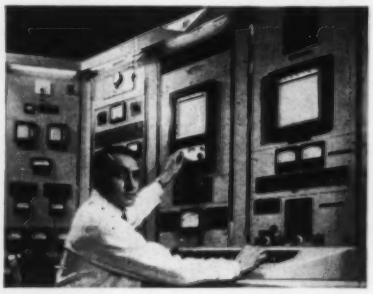
5. Medical Research Reactor. Designed for a southern California university. Fuel: Uranyl sulphate, highly enriched with U-235. Power: 50 kilowatts. Thermal neutron Flux: 1.7 x 10^{12}cm^2/sec. Provision for gamma intensities to 1.3 reb/min per kw, fast neutron intensities of 4 reb/min per kw; also utilization of pure gamma activity of fission gases. Excellent exposure facilities for patient therapy and biological research. First reactor specifically designed for medical use.

6. Industrial Research Reactor for Armour Research Foundation of Illinois Institute of Technology, Chicago. Similar to 5 above, with experimental facilities for industrial applications. This reactor is now operating on a planned schedule that includes "time" for participating companies. This is the first reactor designed specifically for private industrial research.

7. General Research Reactor for Atomic Energy Research Institute, Japan. Similar to the Armour and Medical Research reactors described above. This will be the first nuclear reactor in the Far East, and is slated to be completed in 1957.

ATOMICS INTERNATIONAL has complete designs for reactors with a variety of fuel moderator and cooling systems for various applications, and offers a complete program of services in connection with all reactor projects, including:

- Advice on most suitable reactor type for a specific use
- Assistance in reactor site selection
- Aid in meeting AEC requirements
- Coordination of reactor plans with building plans
- Installation supervision
- Training of operating and maintenance personnel
- Assistance in fuel loading and initial reactor operation
- Design counsel in later modification or expansion
- Assistance in public information



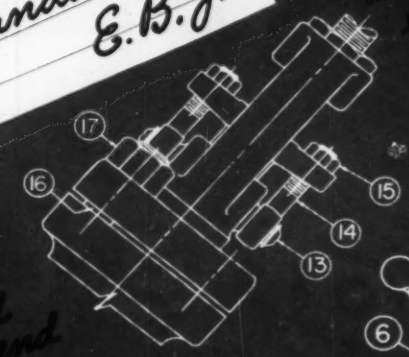
Dr. Marlin Remley of Atomics International activates Armour Reactor—first for private industry.

If you are interested in any phase of our activities, ATOMICS INTERNATIONAL is staffed and equipped to help you. Please write: Director of Technical Sales, Dept. ME-N5, ATOMICS INTERNATIONAL, P.O. Box 309, Canoga Park, California. Cable address: ATOMICS.

ATOMICS INTERNATIONAL
A DIVISION OF NORTH AMERICAN AVIATION, INC.
PIONEERS IN THE CREATIVE USE OF THE ATOM

J. R. P.
Here is an inexpensive, rugged forged steel valve that is quality-controlled to meet the highest standards
E. B. J.

ROCKWELL BUILT
Edward Valves



Large size knobbed handwheel eases operation.

Deep, full-size stuffing box and Evalpack packing combine to minimize maintenance.

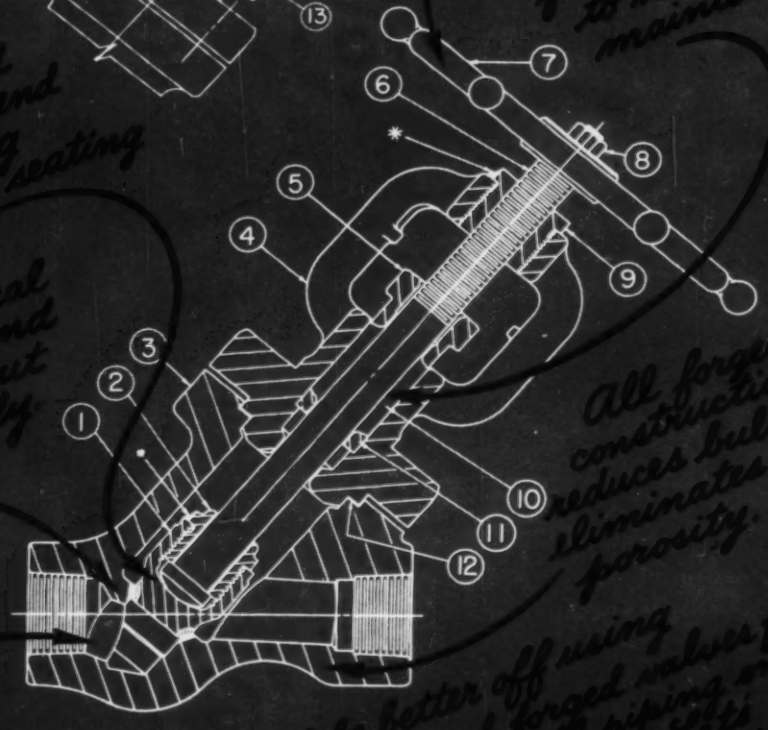
Swivel disk and radiused stem end prevent galling insure perfect seating

Edward integral Stellited seat and Stellited disk cut repairs sharply

Straight through flow minimizes turbulence and pressure drop.

All forged construction reduces bulk—eliminates porosity.

We'll be better off using Edward forged valves for all small piping on our job. Let's get a bid.



LIST OF MATERIAL
QUANTITIES ARE FOR 1 GLOBE OR 1 ANGLE VALVE
WHERE A.S.T.M. SPECIFICATIONS ARE INDICATED THE LATEST REVISION APPLIES

PIECE NO.	NAME OF PIECE	NO. REQ'D	MATERIAL	SPECIFICATIONS	EDWARD MS NO.
1	DISK	1	FORGED ALLOY	A.S.T.M. A182 GRADE F11	227
			STEEL STELLITED		483
2	DISK NUT	1	STEEL	A.I.S.I. G1120	123
3	BODY	1	FORGED STEEL (a)	A.S.T.M. A105, GRADE II	111/483
			FORGED STEEL (b)	A.S.T.M. A182, GRADE F11	227/483
4	BONNET	1	FORGED STEEL (a)	A.S.T.M. A105, GRADE II	111
			FORGED STEEL (b)	A.S.T.M. A182, GRADE F11	227
5	GLAND	1	MALLEABLE IRON	A.S.T.M.A220, GRADE 53004	324
6	STEM	1	EVALLOY	AISI GRADE 416	261
7	HANDWHEEL	1	MALLEABLE IRON	A.S.T.M.A47 GRADE 32510	322
8	STEM NUT	1	STEEL	A.S.T.M. A194 - GRADE 1	124
9	YOKE BUSHING	1	BRONZE	A.S.T.M. B62	412
10	PACKING RINGS		EVALPAK	HIGH TEMPERATURE PACKING	501
11	JUNK RING	1	STEEL - EVALIZED	A.I.S.I. G1120	123
12	BONNET GASKET	1	IRONKOTE		505
13	GLAND BOLT WASHER	2	STEEL		
14	GLAND BOLT	2	FORGED STEEL EVALIZED	A.S.T.M. A105, GRADE II	111
15	GLAND BOLT NUT	2	STEEL - EVALIZED	A.S.T.M. A194 - GRADE O	125
16	TAP END STUD	4	ALLOY STEEL (c)	A.S.T.M. A193	
17	BONNET STUD NUT	4	STEEL (c)	A.S.T.M. A194 -	

EDWARD VALVES, INC.
SUBSIDIARY OF ROCKWELL MANUFACTURING CO.
EAST CHICAGO, INDIANA

FORGED STEEL
GLOBE AND ANGLE VALVES

DRAWN		DRAWING NO
CHK'D		AE-3529-2
APP'D	DATE	

Edward builds Globe and Angle Stop, Non-Return, Check, Stop-Check, Gate, Blow-Off, Mudline, Relief, Hydraulic, Instrument, Gage, and Special Valves and Strainers.

Flush antennas: a creative challenge for Boeing "M.E.'s"

The translucent "window" slightly above and to the right of the man's head is a plastic and glass fiber insulator which electrically isolates the fin tip from the rest of the airplane's structure. This permits the tip to be used as an antenna—one of more than 50 on the Boeing B-52. Many of these antennas take structural loads, and they must function perfectly through extremities of stress, vibration and temperature change. Mechanical engineers were vital in their development.

In this and other projects for airplanes and guided missiles, mechanical engineers investigate new materials and new ways of using them, and devise structures and components to withstand the extreme conditions of high-speed flight. At Boeing, mechanical engineers also find stimulating assignments in controls and mechanisms design, structures and stress analysis, propulsion and thermodynamics analysis, heating, ventilating, and many other fields.

Flush antennas will become increasingly important as planes and missiles enter the hypersonic region. They are just one example of how, at Boeing, engineers find challenging and creative work, and a chance to be leaders in the growth of the engineering art. Because of Boeing's steady expansion, the number of engineers employed by the firm has actually quadrupled during the past ten years. And more engineers are needed for research, design and production on the B-52, the 707 jet transport, the KC-135 jet tanker, the BOMARC IM-99 pilotless interceptor, and on other projects which cannot yet be announced.

Engineers who join Boeing will find, in small and tightly knit project teams, individual recognition and opportunity for professional growth. They will be able to pursue advanced studies with all tuition costs paid by the company, and participate in a liberal retirement plan. There may be an opportunity for *you* to work with outstanding men in many fields at Boeing. Why not find out today?

JOHN C. SANDERS, Staff Engineer — Personnel
Boeing Airplane Co., Dept. F-55, Seattle 24, Wash.

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If you want further information on the advantages of a career with Boeing, please send coupon to either of the above addresses.

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BOEING

Aviation leadership since 1916

SEATTLE, WASHINGTON WICHITA, KANSAS
MELBOURNE, FLORIDA

Pumping Progress Report

FOR MECHANICAL ENGINEERS

An advertisement prepared by the Aldrich Pump Co., Member of Hydraulic Institute, U.S.A.

THE USE OF FLAMMABLE OIL as a hydraulic medium has two major objections — cost and the ever-present danger of fire. Providing a system that would overcome these objections was the problem presented to Aldrich Engineers by a manufacturer of die-cast parts for the automotive industry.

MAKE-UP OIL COST, for this manufacturer, was almost unbelievably high. The fire risk was great. Despite the best efforts of safety control, flash fires were inevitable.

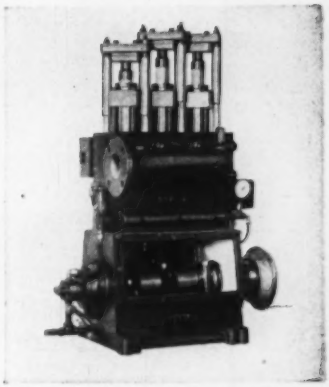
ONE SOLUTION was to pump water as the hydraulic fluid. But the manufacturer knew from experience that an ordinary pump couldn't do this job. What would we recommend?

WATER AS THE HYDRAULIC MEDIUM was our answer. And because Aldrich Direct Flow Pumps can pump water successfully, this manufacturer now operates a low cost, fire-free central hydraulic system. This die-caster gained other advantages by changing to his Aldrich-engineered central system. Aldrich Direct Flow Pumps feature fluid-end sectionalization, with a greater economy of maintenance and repair than was previously possible, horizontal valve action, parts standardization and simplicity of construction.

ALDRICH ENGINEERS will gladly consult with you on any pumping problem. Data Sheets describing the Aldrich series of Direct Flow Pumps will be sent to you on request. Ask for Data Sheet

63 — 2½" Stroke, 25 hp. Triplex
64A — 3" Stroke, 50 hp. Triplex
64, 64B — 5" Stroke, 100 to 200 hp. Series
67A — 6" Stroke, 300 to 900 hp. Series

Address your request to: The Aldrich Pump Company, 29 Pine Street, Allentown, Pa.



2½" Stroke, Triplex "POWR-PAC" Pump

...for your tough pumping problems specify ALDRICH

Solving tough pumping problems has become a specialty with Aldrich. Today, manufacturing plants from coast to coast are performing routine pumping assignments around the clock that were once real headaches for project and plant engineers.

Aldrich Direct Flow Pumps, the basis for solving most of these problems, feature design innovations that provide economies of operation, maintenance and repair in addition to performing jobs not possible with ordinary pumps. If you have a pumping problem, pass it on to us.

TYPICAL METAL WORKING APPLICATIONS FOR ALDRICH PUMPS:

Descaling — Die Casting
Roll Balancing — Press Operation
Hydraulic Testing

Write today for Data Sheets describing the Direct Flow Pump Series.

THE ALDRICH PUMP COMPANY

Originators of the Direct Flow Pump
29 PINE STREET
ALLENTOWN, PA.
Representatives in principal cities

TO THE MEMBERS OF———

THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS

Members of the ASME are invited to name any number of engineers as candidates for membership. Engineering acquaintances should be qualified by both fundamental training and experience for one of the technical grades. Those who do not have an engineering degree may show the equivalent thereof through actual practice. Executives of attainment in science or industry may associate with the Society as Affiliates.

THE American Society of Mechanical Engineers promotes Mechanical Engineering and the allied arts and sciences, encourages original research, fosters engineering education, advances the standards of engineering, promotes the intercourse of engineers among themselves and with allied technologists; separately and in cooperation with other engineering and technical societies, and works to broaden the usefulness of the engineering profession.

As a post graduate school of engineering, the Society brings engineers into contact with each other, with leaders of thought and with new developments; it fosters the interchange of ideas, develops professional fellowships, and encourages a high standard of professional conduct—all with the purpose of advancing civilization and increasing the well-being of mankind.

C. E. Davies, Secretary
The American Society of Mechanical Engineers
29 West 39th Street, New York 18, N. Y.

Date.....

Please send an application and information regarding ASME to the following:

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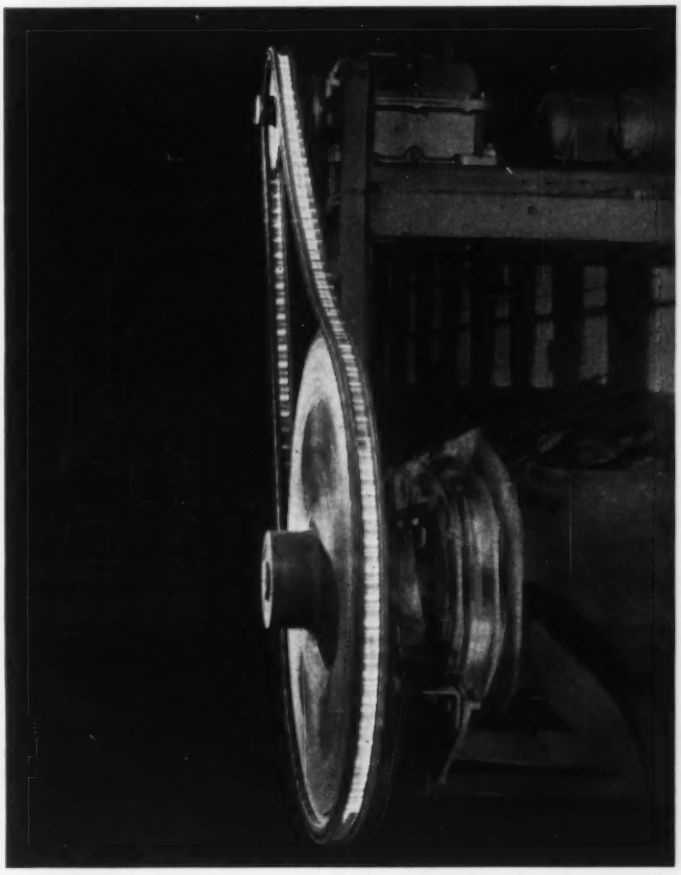
ME-9-56

To static strength . . .

RESISTANCE TO TENSILE STRESS is achieved by use of properly heat-treated, accurately-machined sidebars made of premium steel and fitted with properly-hardened pins, bushings and rollers. But to resist *operational* stresses, additional controls over accuracy, uniformity and roller resiliency are essential.



STRENGTH OF CHAIN IN MOTION is accomplished through tensile strength *plus* special Link-Belt refinements. These include pitch-hole preparation, micro-finish of parts, special processing of sidebars, pre-lubrication and rigid quality control from initial selection of materials to final protective boxing.

LINK-BELT adds great

dynamic strength

that gives Precision Steel Roller Chain on-the-job endurance

WHEN selecting roller chain for your drive or conveying job, durability under actual working conditions is what you're after. That's *dynamic strength*—and it's built into *every length* of Link-Belt Precision Steel Roller Chain. From it comes resistance to such operating stresses as engagement with sprockets, shock of starting loads, centrifugal loads and others.

No one feature can establish high dynamic strength. It results from a combination of Link-Belt "extras" . . . plus other special methods of design, manufacturing and processing. On the job, it means extended life, positive action, less maintenance.

Ask your Link-Belt office or authorized stock-carrying distributor for Book 2457, covering single and multiple width roller chain and sprockets in ¼ to 3-inch pitch . . . and in double pitch, 1 to 3-inch.

LINK-BELT

ROLLER CHAIN & SPROCKETS

LINK-BELT COMPANY: Executive Offices, Prudential Plaza, Chicago 1. To Serve Industry There Are Link-Belt Plants, Sales Offices, Stock Carrying Factory Branch Stores and Distributors in All Principal Cities. Export Office: New York 7; Canada, Scarboro (Toronto 13); Australia, Marrickville, N.S.W.; South Africa, Springs. Representatives Throughout the World. 14.123

LINK-BELT gives you dynamic strength that comes from these important EXTRAS

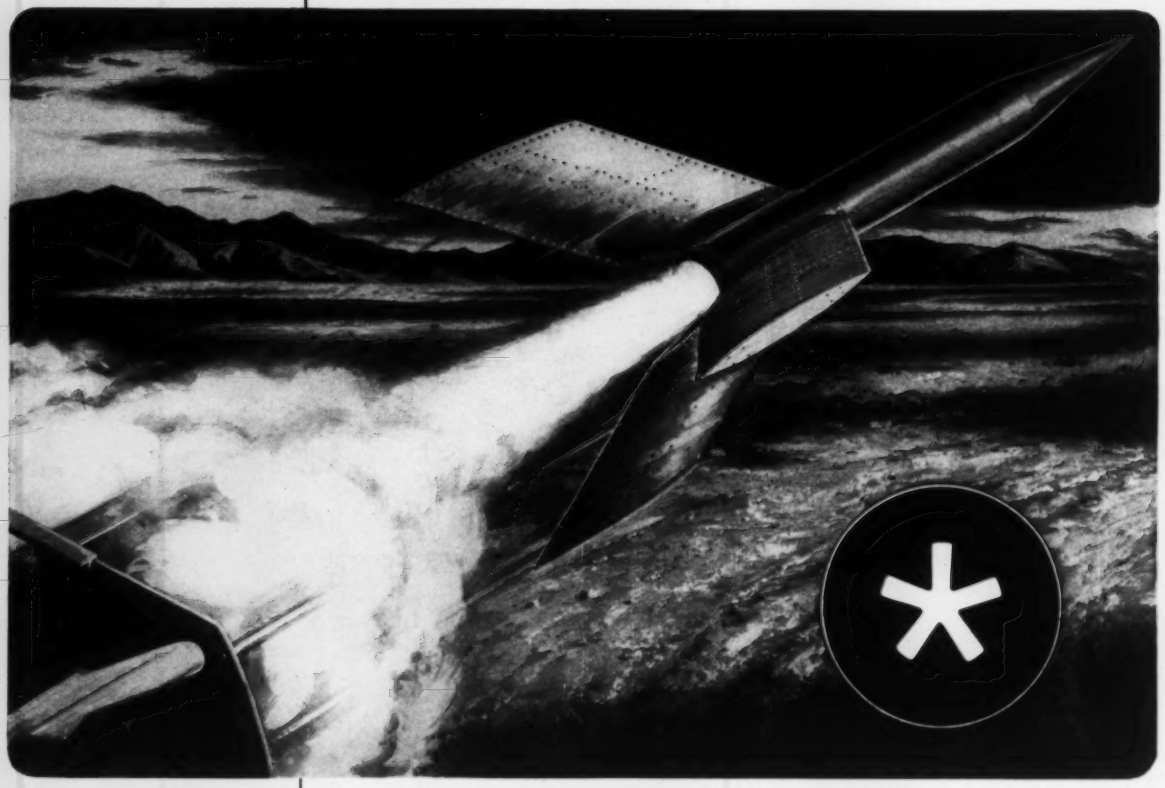
PRE-STRESSING of multiple width chain provides uniform load distribution.

SHOT-PEENED rollers have greater fatigue life, added ability to withstand impact.

CLOSE HEAT-TREAT CONTROL — coupled with rigid testing insures uniformity.

LOCK-TYPE BUSHINGS (applied on a range of sizes) end a cause of stiff chain.

IMPORTANT DEVELOPMENTS AT JPL



Pioneering in Solid Propellant Rockets

The Jet Propulsion Laboratory is a stable research and development center located north of Pasadena in the foothills of the San Gabriel mountains. Covering an 80 acre area and employing 1450 people, it is close to attractive residential areas.

The Laboratory is staffed by the California Institute of Technology and develops its many projects in basic research under contract with the U.S. Government.

Opportunities open to qualified engineers. Inquiries now invited.

The successful flight of the Thunderbird, a short-range test rocket, accomplished a real pioneering achievement at the Jet Propulsion Laboratory in 1947. It was a noteworthy demonstration of a new technique which has since revolutionized the field of solid-propellant rockets.

In the Thunderbird a mixture of oxidizer and synthetic rubber fuel was poured around a star-shaped core set in a cylindrical casing forming as it solidified a permanent bond with the metal shell. The removal of the core leaving a hollow center made possible the even burning of the propellant from the center outward. The insulating effect of the unburned propellant permitted the use of an unusually thin casing due to heat reduction.

This technique led the Laboratory into a number of new developments in missile design which have since been applied to powerplants in many current and forthcoming missiles.

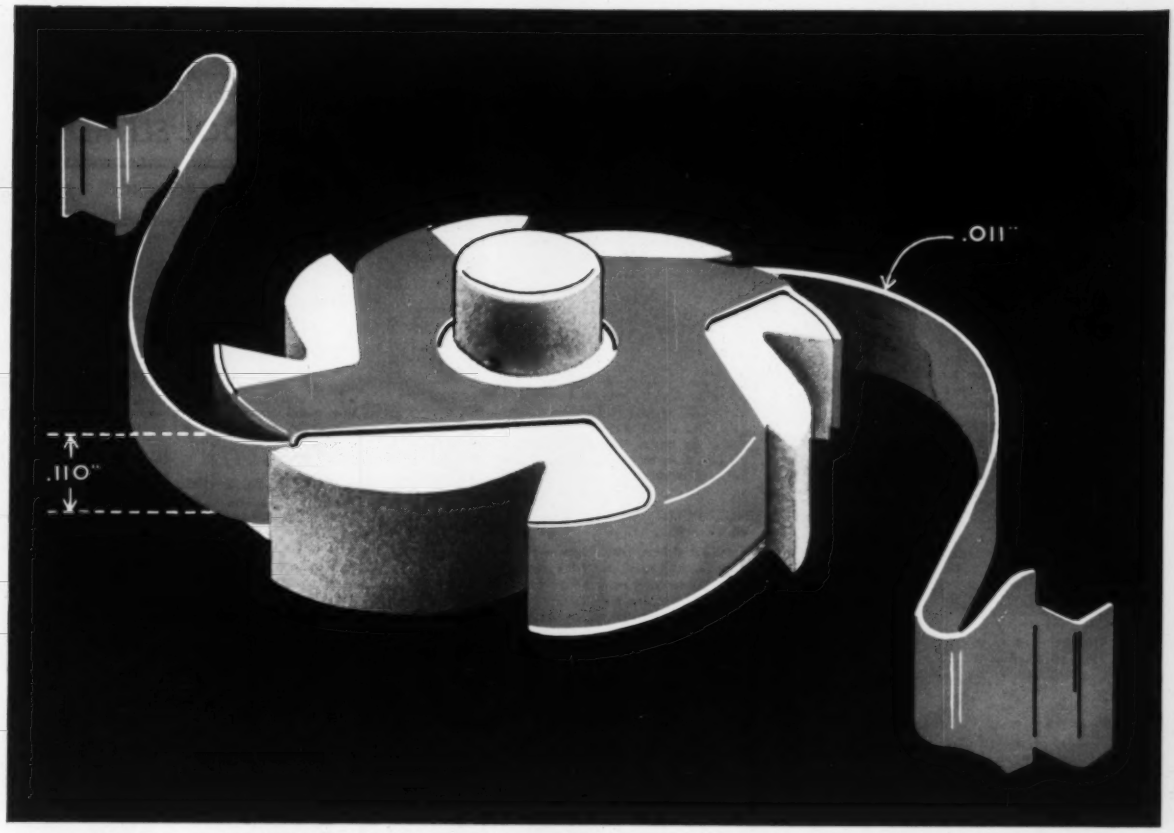
Such activities in research and development are in constant progress at JPL, providing stimulating opportunities to individuals desiring to devote themselves to the areas of basic and applied research and to actual development engineering.

JOB OPPORTUNITIES IN THESE FIELDS NOW

jpl

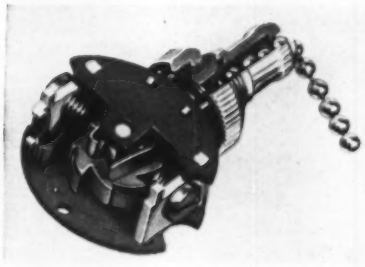
AERONAUTICS • MECHANICAL • STRUCTURES
DYNAMICS • PROPULSION
APPLIED MECHANICS • INERTIAL ELEMENTS

JET PROPULSION LABORATORY
A DIVISION OF CALIFORNIA INSTITUTE OF TECHNOLOGY
PASADENA • CALIFORNIA



Enlargement showing the contact springs at the "heart" of one model of the Levolier® switch mechanism. Levolier switches are used in industrial and commercial lighting, in heavy-duty industrial sockets, in appliances, fixtures, etc.

The Anaconda alloy tailored for this punishing service actually costs less



Cutaway of Levolier Switch No. 41 shown approximately actual size.

THE PROBLEM: The McGill Manufacturing Company, Inc., Valparaiso, Indiana, was interested in a desirable substitute for a premium copper alloy used in contact springs for their widely known Levolier switch mechanisms. Unexcelled quality had to be maintained with a new alloy that would help hold prices against rising costs. As these switches are designed for long service and heavy-duty industrial service, the spring material has to be tough and durable.

THE SOLUTION: In 1952, McGill discussed the problem of an alternate spring material with a metallurgical engineer from The American Brass Company. After an analysis of the requirements, a special Anaconda alloy was offered—Ambronze-422, rolled to spring temper.

Samples were prepared and tested by McGill and Underwriters' Laboratories. The material performed satisfactorily in standard tests—current carrying capacity, 6 amps at 125 volts d.c.—readily exceeded the requirements of 75,000 cycles, or 150,000 individual operations.

In production, the new Anaconda alloy also performed satisfactorily. It was necessary to make only one minor die-forming change. McGill received a desirable saving in material costs—product quality remained high—and the material was available as needed to maintain production.

FREE TECHNICAL SERVICE: This is another example of the Anaconda technical service available to metal users. Sometimes a new alloy is required—other times a variation of a standard alloy will do the job. The Technical Department of The American Brass Company, through its day-to-day work with a wide variety of metal problems, offers a tremendous breadth of experience, which is at your disposal. See your American Brass Company representative or write: The American Brass Company, Waterbury 20, Conn. In Canada: Anaconda American Brass Ltd., New Toronto, Ontario. 5664

ANACONDA® **COPPER AND COPPER ALLOYS**

Here are the AMERICAN STANDARDS to consult—

for approved dimensions, permissible tolerances, and other specifications covering SMALL TOOLS AND MACHINE TOOL ELEMENTS

ACCURACY OF ENGINE AND TOOL ROOM LATHES, B5.16—1952. $1.00
Gives the tolerances to which industry is building 12 in. to 18 in., 20 in. to 32 in., and 40 in. to 72 in. lathes and the tests for determining the accuracy of the lathes.

CHUCKS AND CHUCK JAWS, B5.8—1954. $1.50
Establishes controlling dimensions for all chucks from 6-in. to 36-in. diameter of both medium and heavy duty types, for an extra heavy series of chucks with serrated master jaws, for power-operated and hand-operated chucks of two-, three-, and four-jaw types.

CIRCULAR AND DOVETAILED FORMING TOOL BLANKS, B5.7—1954. $1.50
The 60 types of machines for which tool blanks and holders are provided are classified into six different groups of comparable stock capacities. Dimensions given are for (a) circular tools with threaded mounting hole for groups 1, 2, and 3; (b) circular tools with counter-bored mounting hole for groups 4, 5; (c) dovetailed tools for all six groups; and (d) circular forming and dovetailed tool holders for all six groups.

DRILL DRIVERS (Split-Sleeve, Collet-Type), B5.27—1951. $1.50
This Standard gives taper dimensions, general specifications, and the dimensions for 135 sizes of drill drivers along with the standard and optional taper number for each size.

INVOLUTE SPLINES, B5.15—1950. $3.00
Tables give dimensional and effective clearances, minor diameter fits, dimensions for both the flat root and fillet root types, basic measurements between and over pins, special pin measurements, and hob and broach dimensions. Provisions are made for allowable errors. Formulas are given for calculating pin measurements and torque capacities.

INVOLUTE SERRATIONS, B5.26—1950. $2.00
Presents a uniform, easily fabricated set of serrations. The pitches included are 10/20, 16/32, 24/48, 32/64, 40/80, 48/96, 64/128, 80/160, 128/256 complete from 6 to 100 teeth only for the first three. The Standard makes provisions for allowable errors and effective fits, and includes the basic measurements between and over pins, also tables of maximum tooth space and minimum tooth thickness.

INVOLUTE SPLINE AND SERRATION GAGES AND GAGING, B5.31—1953. $1.50
Factors affecting fits and their control, working and inspection gages, inspection methods, machining tolerances and allowable errors are among the subjects covered.

JIG BUSHINGS, B5.6—1941. (Reaffirmed 1949) $1.00
Dimensions for: Press-Fit Wearing, Renewable-Wearing and Liner Bushings.

KNURLING, B5.30—1953. $1.50
This standard covers knurling tools with standardized diametral pitches and includes dimensional relations with stock in the production of straight, diagonal and diamond knurling on cylindrical surfaces having teeth of uniform pitch parallel to the axis of the cylinder or at a helix angle not exceeding 45 deg with axis of work, such knurling being made by the displacement of the material on the surface when rotated under pressure against a knurling tool.

MOUNTING DIMENSIONS OF LUBRICATING AND COOLANT PUMPS FOR MACHINE TOOLS, B5.28—1952. $1.00
Tables give specific mounting dimensions for motor-driven centrifugal pumps, centrifugal and geared pumps, centrifugal pumps (flange mounted type), gear and vane pumps, and for mounting brackets.

PUNCH AND DIE SETS FOR TWO-POST PUNCH PRESS TOOLS, B5.25—1950. $1.50
These dimensions for back-post and diagonal-post sets cover die area, the die holder and punch holder thickness, shank diameter and lengths, guideposts and bushings, and removable punch holder shanks.

ROTATING AIR CYLINDERS AND ADAPTERS, B5.5—1954. $1.00
These adapters are for cylinders of the following sizes: 3- and 4½-in., 6- and 8-in., 10 to 18 in., and for the 20-in. air cylinder or other power-operated device having a draw rod pull of 26,000 to 40,000 pounds. The length of stroke of the cylinders, the position of the piston rod at the end of the stroke, the diameter of the piston rod, and the size of the tapped hole in the piston rod have also been standardized.

SINGLE-POINT TOOLS AND TOOL POSTS, B5.22—1950. $2.00
Standard defines and illustrates the different classes of tools, their parts, and the angles at which they are used. Dimensions include those for: tool shanks, tool post openings, and lathe center height for solid tools and tool holders, six styles of sintered carbide tips, and the tips and shanks of tipped tools.

MARKINGS FOR GRINDING WHEELS, B5.17—1949. (Reaffirmed 1953) $1.00
Covering markings only, this Standard establishes a symbol for each of the most essential characteristics of a grinding wheel and arranges them in uniform sequence.

SPINDLE NOSES FOR LATHES, B5.9—1954. $2.50
These Spindle noses are for use on tool room lathes, engine lathes, turret lathes, and automatic lathes. Dimensions cover each size and type of nose; mating backs of chucks, face plates, and fixtures; and gages for checking important dimension on spindle noses and on back of chucks, face plates, and fixtures. Tolerances are specified, each type of spindle nose is described, and recommendations are given for its use for different types of lathes.

SPINDLE NOSES AND ADJUSTABLE ADAPTERS FOR MULTIPLE SPINDLE DRILLING HEADS B5.11—1954. $1.00
Here are the general dimensions of assembly and the detail dimensions of adjustable adapter body, set screw slot, adjustable extension adapters, adjustable adapter set screw and friction lock nuts, and spindle noses. Tolerances, finish and marking are specified.

SPINDLE NOSES AND ARBORS FOR MILLING MACHINES, B5.18—1953. $1.00
Contains dimensions for ends of arbor and adapter, for spindle nose, and for draw-in bolt end; also sketches of selective types of drive key construction.

STRAIGHT CUT-OFF BLADES FOR LATHES AND SCREW MACHINES, B5.21—1949. $1.00
Gives dimensions for the height, length, and thickness of the approved four types of blades, and includes sketches to show the optional shapes for cut-off blade stock.

T-SLOTS, THEIR BOLTS, NUTS, TONGUES, AND CUTTERS, B5.1—1949. $1.50
While recommending a width of throat greater than the nominal diameter of the bolt, provisions are made for an alternative standard having the throat width equal to the nominal diameter of the bolt. Other recommendations provide for the use of a stud of a smaller size than the T-bolt for the corresponding slot; that T-bolts, nuts, and slots be known by the diameter of the bolt, and for chamfering corners.

LIFE TESTS OF SINGLE-POINT TOOLS, B5.19—1946. (Reaffirmed 1953) $1.00
These tests apply to speed, feeds, depth of cuts, shape and size of tools, Rockwell hardness, shape and size of test logs, etc.

LIFE TESTS FOR SINGLE-POINT TOOLS OF SINTERED CARBIDE, B5.34—1956. $1.00
Recommendations apply to the tool shape, the preparation of the tools for tests, and the methods of testing to determine relationship between tool wear and cutting time. Illustrations are given showing progressive tool wear on a given type of sintered carbide tool when turning three types of steel at 700 Fpm and a Feed of 0.0077 Ipr; tool angles, and a typical cutting speed tool-life line drawn through several experimental points on Log-Log paper to give the equation $VT^n = C$.

TWIST DRILLS, B5.12—1950. $1.50
Provides dimensions and tolerances for standard straight shank drills varying from 0.0135 to 2.000 in. taper shank drills from ⅛ in. to 3½ in.; and the corresponding drill lengths and flute lengths.

DESIGNATION AND WORKING RANGES OF GRINDING MACHINES, B5.32 and 33—1953. $1.00
Provides a method of identifying machine tools so that a user can specify reasonable similar sizes and capacities by means of simple designation. The section on reciprocating table surface grinders covers all sizes having horizontal spindles, and recommends the wheel sleeve diameters, width and length of working surface, the longitudinal transverse and vertical travel. The second section deals with the swing of plain cylindrical grinding machines up to and including the 36 inch size.

MACHINE TAPERS, B5.10—1953. $1.50
Presents basic dimensions for 22 sizes of self-holding tapers; detailed dimensions and tolerances for self-holding taper shanks and sockets, for the plug and ring gages applying to this series of tapers; and the dimensions for 12 sizes of steep machine tapers.

MACHINE PINS, B5.20—1954. $1.00
These dimensions are for: hardened and ground dowel pins, straight pins, ground dowel pins (not hardened), taper pins, clevis pins, and cotter pins. An appendix gives specifications for taper pins and a drill chart for the size of drill and number required.

MILLING CUTTERS, B5.3—1950. $3.00
Reflecting the developments in cutter design, tool material, and machine improvements are the 56 illustrated types for which dimensions are here given.

REAMERS, B5.14—1949. $2.00
General dimensions of thirty standard types of reamers and related tools are presented along with the magnitude and direction of the tolerances including the number of flutes in the various types.

TAPS—CUT AND GROUND THREADS, B5.4—1948. $2.00
32 tables gives the thread and general dimensions together with the working tolerances for nine types of taps. Supplementary material includes terminology and definitions; and instructions for marking taps, dies, and other threading tools.

BINDERS

A specially designed binder for holding these Standards is available. It is 9" x 12" in size and provided with flexible steel rods which can be slipped out of or under the top and bottom metal lips. It gives every advantage of a bound book together with the added convenience which comes from the ability to instantly insert, remove or transpose sections of the contents. **Price, $3.25**

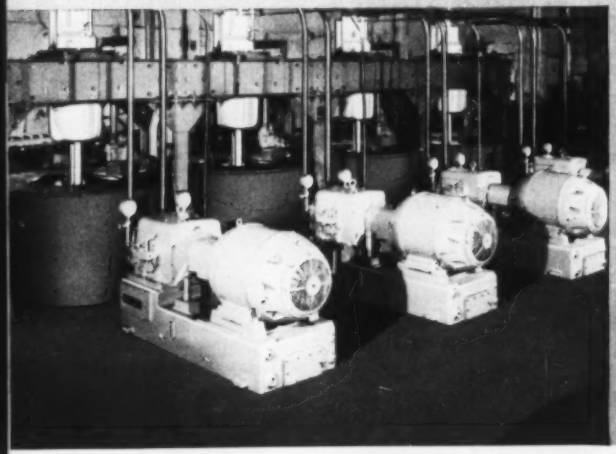
20% Discount to ASME Members

Published by **THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS, 29 W. 39 ST., N. Y. 18**

Any speed for you too!

Unique Oilgear Fluid Power "ANY-SPEED" Drives establish new production and economy records

Any desired speed from zero to maximum . . . any rate of acceleration . . . any rate of deceleration . . . any rate of hydrodynamic braking . . . any speed adjustment between operations . . . synchronization of two or more drives . . . direct or remote precision speed control irrespective of load, input power or oil viscosity changes . . . all with Oilgear Fluid Power "Any-Speed" Drives. Old and new users name them *"the drives"* for their heavy-duty needs. You probably didn't know this! Every day, people are equally surprised—*and far more amazed when they know the facts.* Write and get them *now*. THE OILGEAR COMPANY, 1570 W. Pierce Street, Milwaukee 4, Wisconsin.



This Centrifuge at Abbott Laboratories

Leading house in pharmaceutical, drug and chemical field, Abbott Laboratories installed first Oilgear Drive on Tolhurst centrifuge in production department. Experience was so satisfactory it led to the inclusion of another Oilgear equipped Tolhurst centrifuge in their experimental laboratories.

SPECIFICATIONS: Speed continuously variable from zero to 1200 rpm max. (in this case). Full control of acceleration/deceleration speed and rate. Permits that infinitely modifiable speed best suited to loading, washing, spinning and unloading.

Photo Courtesy, Chemical Processing Magazine

This Centrifuge at powder plant in east

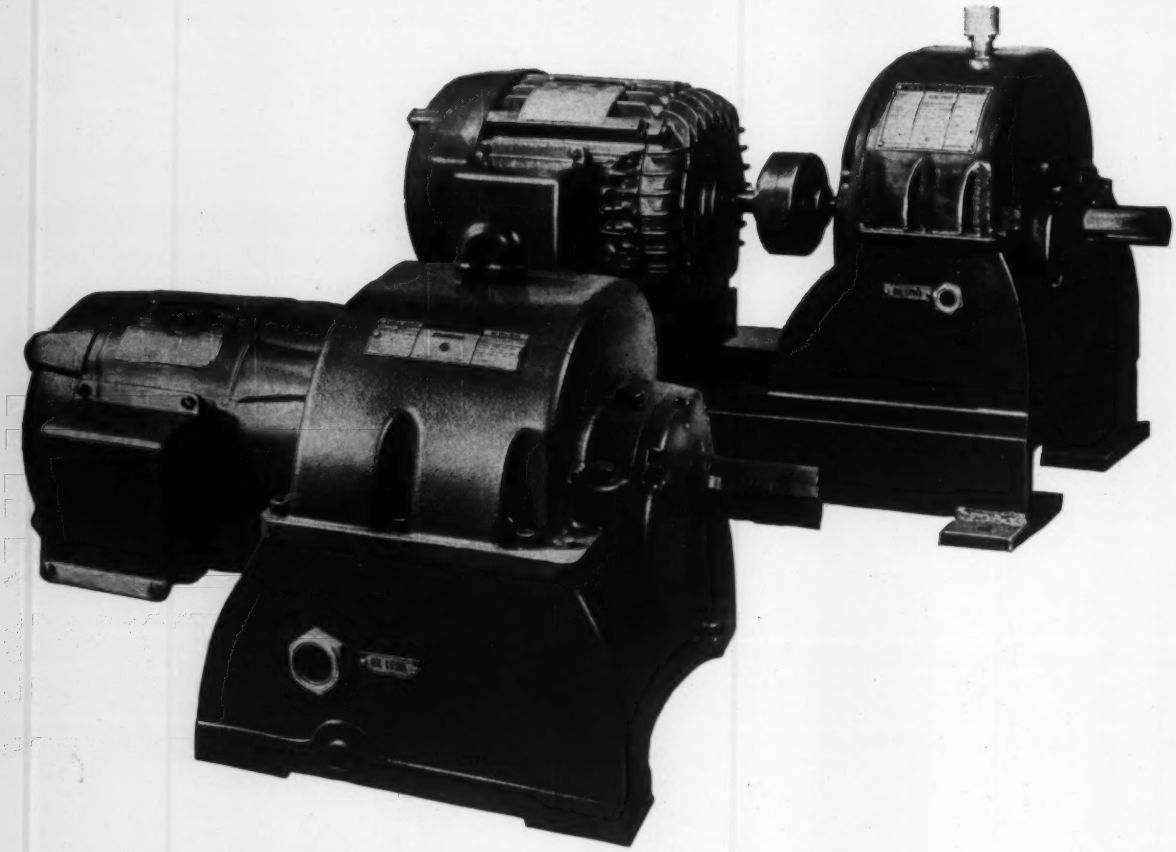
In a somewhat different application, these 4 Oilgear 60 hp "Any-Speed" Drives serve Tolhurst centrifuges in powder plant in the east. Centrifuge accelerates to 300 rpm for loading, to 900 rpm for 15-minute centrifuging, then decelerates to 70 rpm for "plowing." Unloading is automatic.

Tolhurst is a division of American Machine & Metals, Inc.

OILGEAR
Fluid Power

PIONEERS . . . NOW THREE PLANTS FOR FLUID POWER

PUMPS, MOTORS, TRANSMISSIONS, CYLINDERS AND VALVES



GEARMOTOR OR PACKAGED DRIVE?

Your selection has a longer future with Westinghouse BPT gearing

Westinghouse gearmotors and DB packaged drives offer important advantages to simplify drive problems and provide long-range dependability.

First, you'll find both lines of gearing readily available. They provide a wide selection in horsepower, speed ratios, direction of power take-off, mounting and coupling methods. This sort of flexibility is bound to save you time in answering space and load problems.

Second, Westinghouse BPT gearing, in both lines, assures a long-range solution to any drive problem. The exclusive BPT heat-treatment process produces unmatched, long wearing, shock-resistant qualities as a result of taper hardening each gear tooth. Heavy-duty, antifriction bearings also insure continued high efficiency under changing load demands.

Get all the facts on Westinghouse gearmotors and DB packaged drives today from your local Westinghouse salesman; or write Westinghouse Electric Corporation, 3 Gateway Center, P. O. Box 868, Pittsburgh 30, Pennsylvania.

J-07351

Exclusive BPT heat-treatment produces a taper hardness from surface to core of each gear tooth for toughness and hardness.

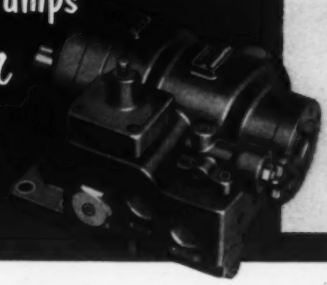
WATCH WESTINGHOUSE!

*WHERE **BIG** THINGS ARE HAPPENING **TODAY!***

Do You Want To Save Horsepower and Heat?

VICKERS

Two-Pressure Oil Hydraulic Pumps Require Less Power for Two-Pressure Circuits



Automatically Provide

High Volume @ Low Pressure for fast closing, rapid advance, and rapid return.

•

Low Volume @ High Pressure for feeding, compressing, clamping, and holding.

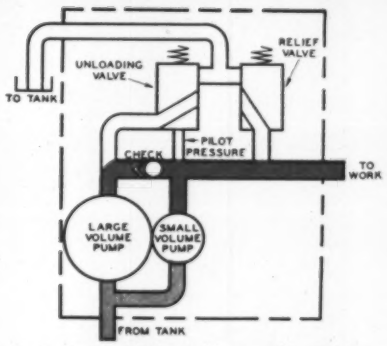


Fig. 1 Combined Delivery of Large and Small Volume Cartridges at Low Pressure

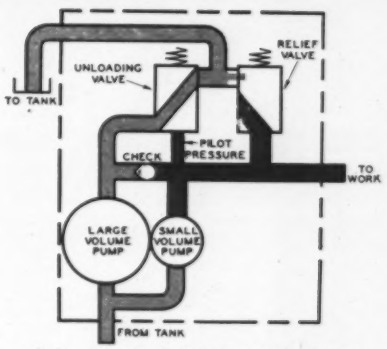


Fig. 2 Delivering Small Volume at High Pressure

Two Vickers Vane Type pumping cartridges are mounted on the same shaft—in the same housing, driven by the same prime mover. One provides a large volume of oil while the other delivers a small volume. These Vickers Two-Pressure Pumps have proved advantageous in a wide variety of applications.

For example, in closing a press or in rapid advance, both pump cartridges work together, supplying maximum volume for quick operation (see Fig. 1). When the press is closed and compression begins, or when the tool goes into feed immediately prior to beginning the cut, the large volume cartridge is automatically unloaded to the reservoir at zero pressure (see Fig. 2). The small volume cartridge alone then provides the lower volume required at high pressure.

These Vickers Two-Pressure Pumps are most economical in power consumption for such two-pressure operation. The reason for this is that a small-volume pump working at full capacity is MORE EFFICIENT than a large-volume pump working at partial capacity. Regardless of momentary delivery, the internal leakage of any pump is proportional to its size and operating pressure. The chart (Fig. 3) shows an interesting comparison between a Vickers Two-Pressure (Two-Volume) Pump and a variable volume vane type pump on a press circuit.

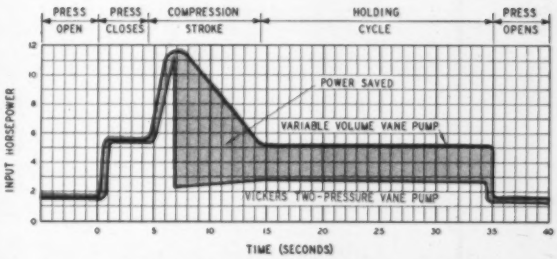


Fig. 3. On this typical press application the saving in power is approximately 50% with a resultant saving in heat in the system.

Like all Vickers Vane Pumps, these two-pressure pumps have the hydraulic balance feature that relieves bearings of all pressure loads (one of the major causes of wear). Cartridge construction enables customer to service in his own plant instead of returning to factory should repairs be necessary. Relief and unloading valves are integral . . . minimizing piping and connections. Complete range of sizes up to 48 gpm. For additional information, ask for Bulletin 54-70a.

6895

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DIVISION OF SPERRY RAND CORPORATION
ADMINISTRATIVE and ENGINEERING CENTER
Department 1500 • Detroit 32, Michigan

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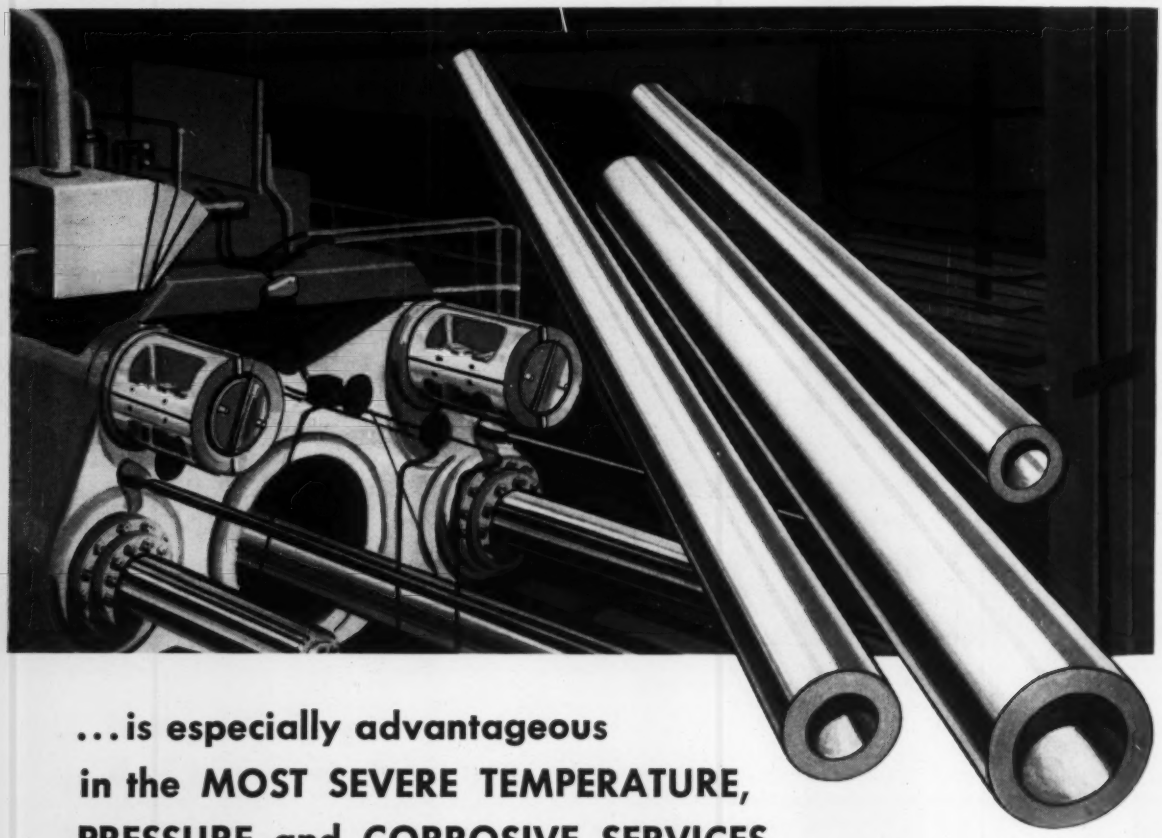
ENGINEERS AND BUILDERS OF OIL HYDRAULIC EQUIPMENT SINCE 1921

HIGH INTEGRITY

EXTRUDED ALLOY STEEL PIPE

available from 4″ to 22″O.D. in practically any wall thickness



...is especially advantageous in the MOST SEVERE TEMPERATURE, PRESSURE and CORROSIVE SERVICES

A specially-built 12,000 ton extrusion press – capable of processing any of the stainless or other ferrous alloys – imparts vastly improved mechanical properties to new Curtiss-Wright ***HIGH INTEGRITY*** pipe. *High ductility with high strength* and *higher resistance to stress at high temperature* are automatically built into even the largest diameters and thickest-wall products. In the larger diameters, 10″ and above, the economics of ***HIGH INTEGRITY*** pipe are particularly attractive.

Major economies are regularly effected in fabrication and installation . . . using the longer units – up to 50 feet. Ultrasonic testing of all ***HIGH INTEGRITY*** pipe – combined with the more conventional test methods – assures uniform, dependable, specification quality of delivered product.

Curtiss-Wright's Metals Processing Division maintains qualified engineering personnel at all branch offices, available for design consultation and specification pricing.

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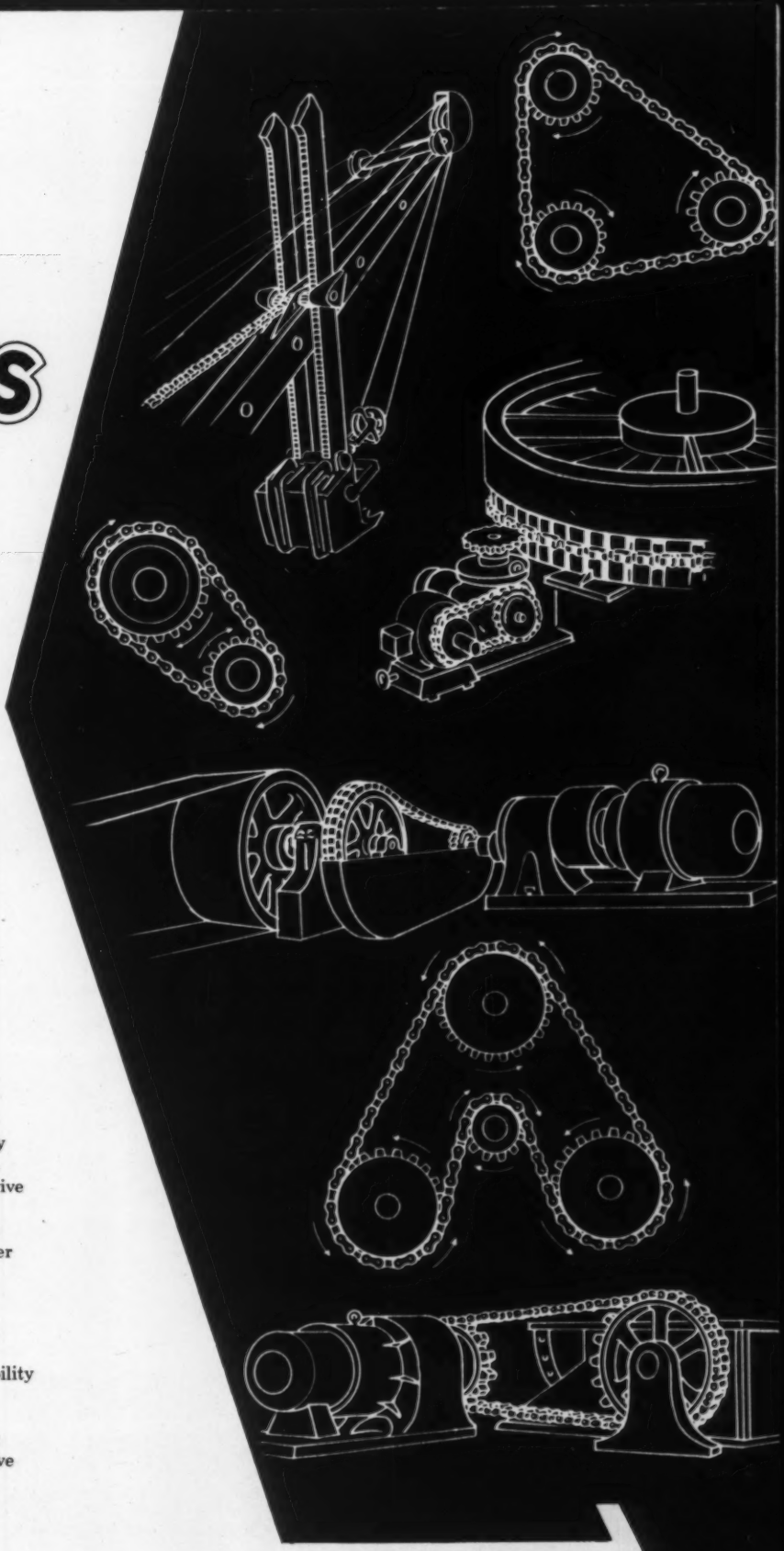
Idea Sparkers

for

MECHANICAL POWER TRANSMISSION



We wonder, every so often, why many designers seem to take mechanical power transmission mediums for granted — never really try to find a better way of doing it. We're puzzled whether they are really familiar with the many advantages of power chain drives.

So often we see misapplications — gears or belts used when chains are the better choice and vice versa. More important to us, we frequentiy see the wrong type of chain used — a high speed chain on a slow speed drive . . . a heavy chain on a light load drive. Costly, inefficient applications like this make us wince. Because, after all, there's a *right* chain . . . a *right* size . . . for each application.

Chains have many design advantages . . . so much flexibility . . . that are often overlooked. For example, the ability to resist heat, dust and dirt . . . virtually unlimited choice of center distances . . . space and weight saving advantages . . . offer the imaginative designer almost unlimited opportunity for creative engineering.

TURN THIS PAGE FOR MORE INFORMATION

CHAIN BELT COMPANY

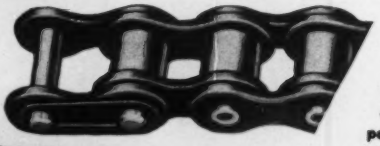
LEADERSHIP . . . through creative engineering

IDEA SPARKERS *(CONTINUED)*

Next time you have a drive problem, why not take advantage of the design flexibility of power drive chains? Our engineers will be happy to work with you. You'll probably save money, increase efficiency. Just mail the coupon below.

There's a right chain for every drive in the complete CHAIN Belt line

REX CHABELCO STEEL CHAINS . . . rugged, heavy-duty chains for slow to moderate-speed, heavy-load drives. Ideal for operation in exposed conditions . . . built-in clearances permit operation in conditions of dust and dirt. Construction equipment, heavy plant drives, elevators, conveyors, drilling rigs, are typical of the type of service where it outperforms other chains.



REX ASA ROLLER CHAINS . . . precision-built chains for moderate to high-speed drives. Exclusive pitch control system assures longest possible service life. Used for all types of drive service such as agricultural implements, packaging machinery, conveyor drives, lift trucks, drilling rigs, mining machinery, printing machinery and general industrial drive service.

REX OFFSET SIDE BAR ROLLER CHAINS combine the high-speed service features of ASA roller chain with the strength and flexibility of Chabelco Chains. Special "built-in" clearances and alloy-heat-treated pins assure long service life under severe operating conditions. They are especially suited to heavy-load operation under dusty, dirty conditions.

REX LEAF CHAINS. While not properly described as power drive chains, these rugged chains are ideal for tension linkage service . . . counterweight mechanisms, reciprocating motions, load carrying, etc. They are widely used on lift trucks where their construction assures greater ultimate strength for a given chain weight, size and cost than with any other chain.

CHAIN Belt Company
Dept. DP-2
Milwaukee 1, Wis.

☐ Send me informative literature on Rex Drive Chains.
☐ I would like to have a CHAIN Belt District Sales Engineer call.

NAME .....
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These are but a few of the many types of Rex Chains for power drive service. There is a right size and type for any application.

CHAIN BELT COMPANY

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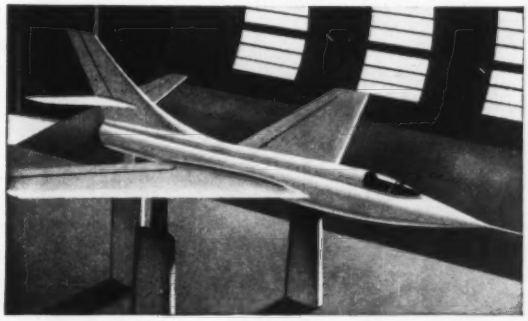

To plan tomorrow's aircraft...

Brush System records performance in new supersonic wind tunnel

ENGINEERS at N. A. C. A.'s Lewis Flight Propulsion Laboratory use Brush Recording Systems to get the facts on model performance in their new supersonic wind tunnel. This work will help determine the shape of future aircraft.

This N. A. C. A. facility has a 10′ x 10′ test area with air velocities above Mach-2. The instrumentation measures transient pressures at various points, as well as fluctuating aerodynamic forces.

With Brush equipment, test results are recorded clearly, accurately, instantaneously. Brush offers the most flexible direct writing systems available—a choice of ink and electric writing in the same units . . . chart speed range from 10″ per day to 10″ per second.

For virtually any type of measurement, you can obtain the facts quicker and easier with Brush equipment. Consult your Brush representative, or write Brush Electronics Co., Dept. P-9, 3405 Perkins Avenue, Cleveland 14, Ohio, for complete information

BRUSH ELECTRONICS COMPANY
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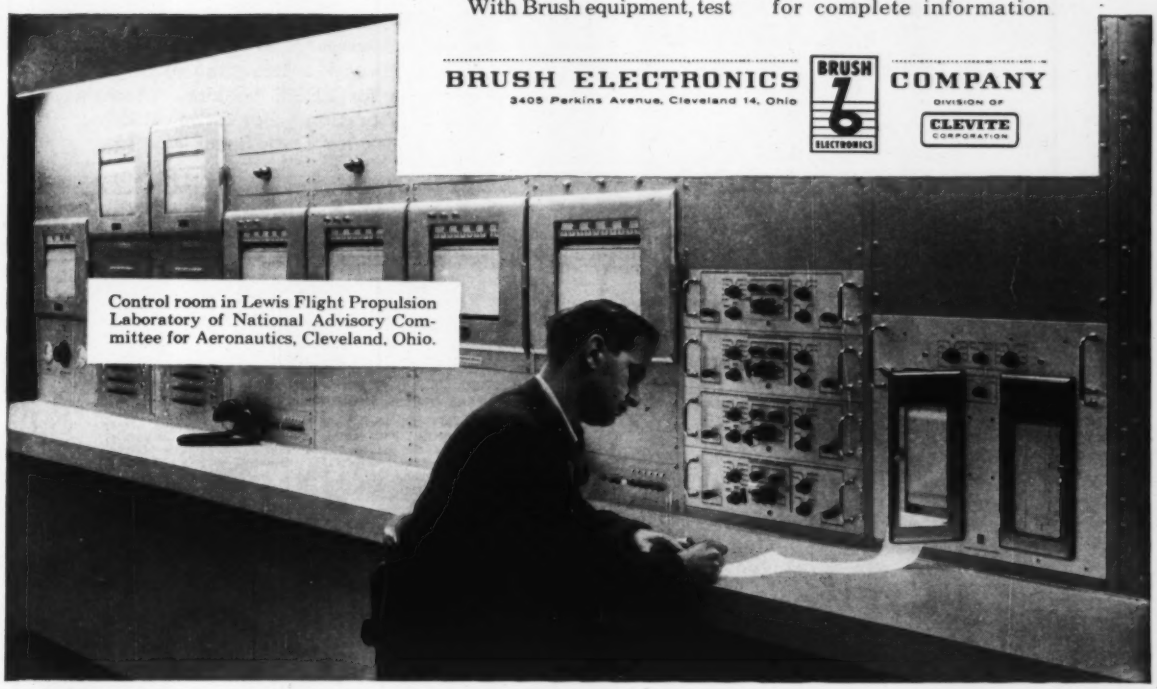
BRUSH ELECTRONICS — DIVISION OF CLEVITE CORPORATION



Control room in Lewis Flight Propulsion Laboratory of National Advisory Committee for Aeronautics, Cleveland, Ohio.

This FELT can CONTROL that Vibration!

When machinery has the shakes, put it on Vibra-Mount* Felt. This resilient cushion greatly reduces the amount of vibration transmitted to the floor, as much as 85%. People are happier, buildings safer. Vibra-Mount Felt is long lived because it takes compression with a minimum of set. In almost every case lag bolts are unnecessary, so machines can be rearranged with a minimum of difficulty. Write for FREE booklet, "How to Reduce Vibration." For technical information, ask for Data Sheet No. 10.

*T. M. Reg.

American Felt Company
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GENERAL OFFICES: 50 GLENVILLE ROAD, GLENVILLE, CONN.

SALES OFFICES: New York, Boston, Chicago, Detroit, Cleveland, Rochester, Philadelphia, St. Louis, Atlanta, Greenville, S. C., Dallas, San Francisco, Los Angeles, Portland, San Diego, Seattle, Montreal.—PLANTS: Glenville, Conn.; Franklin, Mass.; Newburgh, N. Y.; Detroit, Mich.; Westerly, R. I.—ENGINEERING AND RESEARCH LABORATORIES: Glenville, Conn.

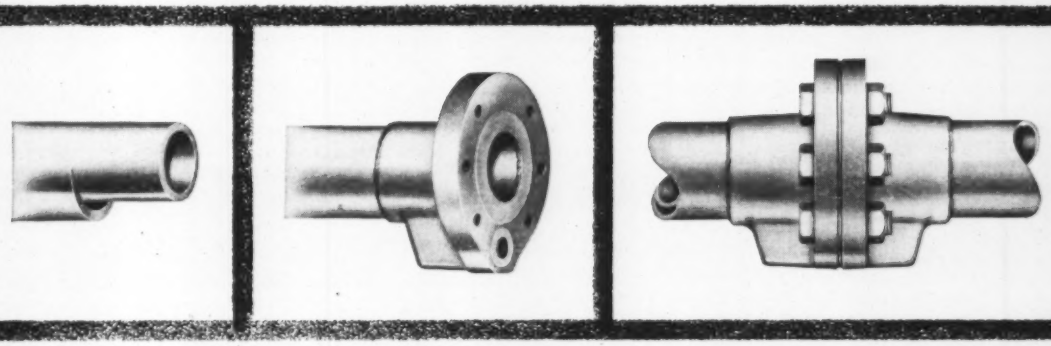
Completing the new concept in steam-traced pipe . . .

NEW ALCOA FLANGE

Makes joining UNITRACE sections as simple as 1, 2, 3

ALCOA created UNITRACE®, a new concept in steam-traced pipe . . . steam and product passages extruded in a single unit of corrosion-resistant ALCOA® Aluminum. The new UNITRACE flange, cast in ALCOA Aluminum alloy A356-T6, adds simple, efficient joining to that concept. Both steam and product passages are cast as integral parts of the flange, thereby eliminating product "freezing" at the joints.

With UNITRACE and the new UNITRACE flange, you can save up to 30% on labor while cutting material and insulation costs. Get the full story today! Write for new illustrated booklet, *Alcoa Unitrace*. Address: Aluminum Company of America, 908-J Alcoa Building, Pittsburgh 19, Pennsylvania.



With this new Alcoa flange, three simple steps create efficient UNITRACE joints: (1) Cut back trace lines 1¾" from the ends of sections to be joined, (2) Slip flanges into place and weld their front faces and necks to the sections with 4043 weld wire, and (3) Bolt flanges together.

Two separate gaskets seal product and steam passages between mating flanges. Bolt holes mate with standard 150-pound, 2-inch ASA pipe flanges and fittings for easy joining to other piping and equipment.

ALCOA ALUMINUM
ALUMINUM COMPANY OF AMERICA

THE ALCOA HOUR
TELEVISION'S FINEST LIVE DRAMA
ALTERNATE SUNDAY EVENINGS

Johns-Manville organizes to give you better insulation service

New and separate insulations division created to provide industry greatly improved Sales and Engineering service to meet modern problems

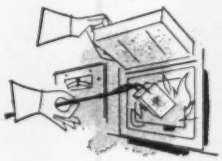
• Johns-Manville is now concentrating all industrial insulation operations within a new, fully integrated insulations division. This greater specialization makes possible the most complete insulation service available to industry. It consists of—

Sales Representatives . . . men on whom you can rely for your insulation recommendations. Your J-M salesman will help you select the insulating material exactly right for your job—the one that will provide maximum fuel savings, improved process control, and minimum maintenance. As co-ordinator of J-M's extensive research-engineering-manufacturing facilities, he offers you outstanding insulation training and experience.

Insulation Engineers—Backing up the J-M salesman on every job is the J-M insulation engineer. He is primarily concerned with solving insulation problems. He recommends the economic thickness of insulation, as well as the proper finishes, weatherproofing and securement. His highly specialized knowledge makes possible an intelligent recognition and handling of your individual insulation requirements.

Insulation Contract Units . . . Fully aware that no insulation is better than the man who applies it, the J-M Insulation Contractor makes care and skill in the scientific application of Johns-Manville insulations his stock in trade. He maintains a complete crew of estimators and mechanics trained in J-M application techniques. He is ready to give you fast, efficient service on any insulation job—large or small. Proud of his reputation for integrity in his own community, the J-M Insulation Contractor merits your complete confidence.

Complete Range of Products—In this day of exacting temperature control, the need for specific insulations for specific services is greater than ever before. Recognizing this, Johns-Manville manufactures insulations for every industrial requirement. Produced from the finest grades of asbestos, magnesium carbonate, diatomaceous silica, refractory clays and ceramic fibers, they are designed to afford maximum insulating effectiveness and durability at operating temperatures ranging from minus 300F to plus 3000F.



Extensive Research Facilities—At Manville, New Jersey, Johns-Manville maintains the world's most completely equipped insulation laboratory. Here insulation scientists are engaged in a continuous program of developing new and better insulating materials. In addition, their technical knowledge is always available to J-M customers whose insulation problems require special study.

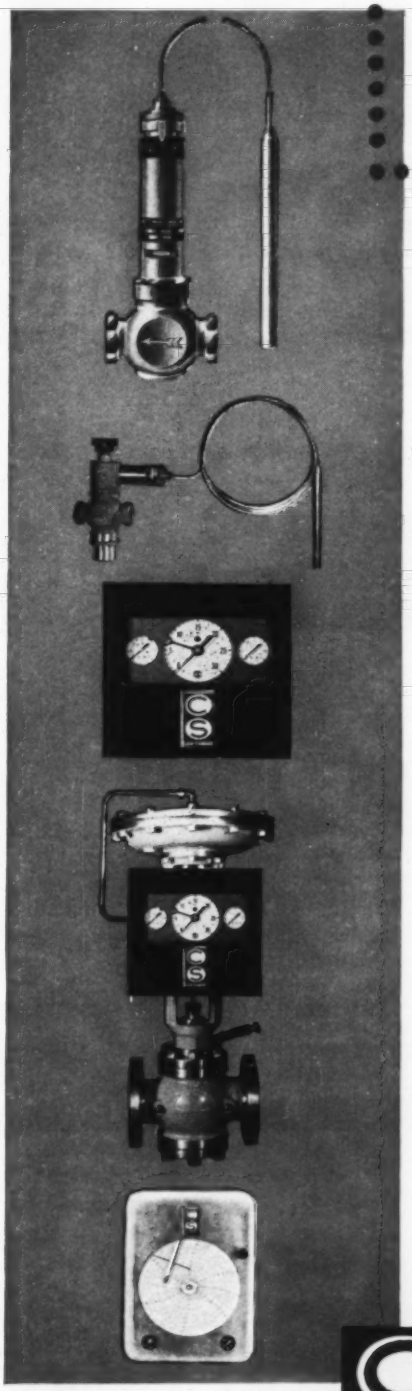
Experienced Management—At headquarters as well as in the field, management of the new insulations division consists of men who, in line with J-M's promotion-from-within policy, are insulation veterans. With a realistic grasp of customers' needs, they are alert to new and better ways to serve you . . . now, and in the future.

On Your Next Insulation Job—Whether your next insulation job is big or little, simple or complex, let Johns-Manville handle it for you. Just call your nearest J-M sales office, or write direct to Johns-Manville, Box 14, New York 16, New York. In Canada, Port Credit, Ontario. *Chances are, you'll be glad you did!*

Johns-Manville *first-in* **INSULATION**

MATERIALS · ENGINEERING · APPLICATION

For Accurate, Reliable Temperature Control



STACON V SERIES
Self Operating Temperature Regulators—

Feature a liquid filled thermal system for high operating power and uniform throttling action and has built-in over-load protection. Available in 50°F. and 100°F. ranges from 25° to 325°F. Direct and reverse acting units ¼" to 1½" with screwed ends, and 2" to 4" with flanged ends. Bulletin No. 500. (Cash Standard Stacon Corp.)

STACON TYPE VS
Temperature Safety Regulators—

Used in the supply steam or gas line and will protect a process by snapping shut when the process temperature goes above a desired temperature level. Easily adjustable and remains closed until manually reset. Available in sizes from ½" to 1½" with screwed ends. (Cash Standard Stacon Corp.)

CASH STANDARD TYPE 51
Indicating Controllers—

An air operated, mercury actuated proportional temperature controller. Temperature ranges from —40°F. to 1000°F. Calibrated set point adjustment, unit construction, air relay with sapphire orifice and push button cleaner, feedback type proportional control with 1-100% band and differential gap. Also available with 1-150% proportional band combined with automatic reset action. Bulletin No. 978. (A. W. Cash Co.)

CASH STANDARD TYPE 30
Diaphragm Control Valve (With Type 51 Mounted)

A rugged, dependable control valve—available in sizes ½" to 12" with various styles of inner valves—reverse or direct acting. Accurate control is assured when the Type 30 is used with 51 or 57 controllers, valve mounted as illustrated, or where the controller is installed remotely. Bulletin No. 980. (A. W. Cash Co.)

CASH STANDARD TYPE 57
Recording Controllers—

An air operated temperature controller with mercury, vapor, gas or organic liquid actuation. Temperature ranges from —350°F. to 1200°F. Available in 9" and 12" case size, spring or electric driven chart drive, on-off control or 1-100% proportional control.

All units have push button nozzle cleaner; proportional controllers also have sapphire jewelled relay orifice with push button cleaner. Bulletin No. 979. (A. W. Cash Co.)

WHAT'S *YOUR* TEMPERATURE CONTROL PROBLEM?

Cash Standard and Stacon have the answer or will find one.

Contact the Cash Standard temperature and pressure control specialist in your area, or write Dept. A

CASH CS STANDARD

A. W. Cash Co. and Its Subsidiary, Cash Standard Stacon Corp.
P. O. Box 551, Decatur, Ill.

PRESSURE, HYDRAULIC, TEMPERATURE, PROCESS AND COMBUSTION CONTROLS

Inside story:

Valves may look alike on the surface. Their performance is another story. And the inside story of Powell Valves is that *every* Powell Valve has *Performance Verified.*

X-ray and gamma ray inspection—examining the very structure of the metal itself—are two of the many ways that Powell can make absolutely certain that Powell Valves will give *dependable* flow control.

Every part of every valve must pass rigid inspection. As a final step in manufacture, every Powell Valve is subjected to *an actual line test.* Because of Powell's pains-taking quality control, valve repair is cut to the minimum and plant shut down through valve failure is substantially reduced. Records from refineries, power and industrial plants the world over prove it.

Consult your Powell Valve distributor. If none is near you, we'll be pleased to tell you about our COMPLETE *quality line* which has PERFORMANCE VERIFIED.

The Wm. Powell Company, Cincinnati 22, Ohio . . . 110th YEAR

PERFORMANCE PV VERIFIED

FIG. 19003 WE—900-Pound Steel Pressure Seal Gate Valve.

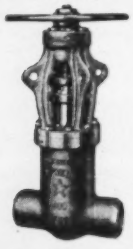


FIG. 11365 WE—Steel Pressure Seal Horizontal Lift Check Valve for 1500 Pounds W.S.P.

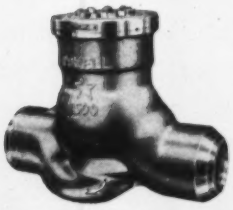
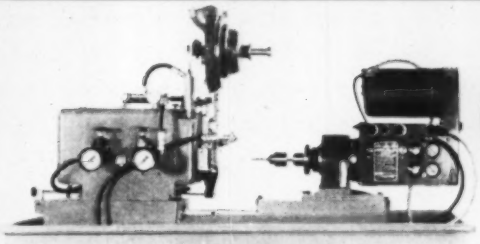


FIG. 3031 WE—Steel Globe Valve for 300 Pounds W.S.P.

POWELL VALVES

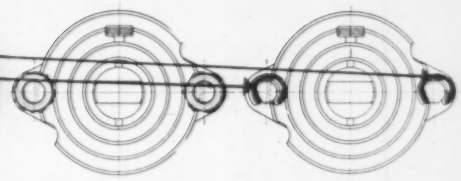
BRONZE, IRON, STEEL AND CORROSION RESISTANT VALVES.

Waldes Truarc Retaining Rings Eliminate Machining and Parts—Cut Assembly Time on Drill and Tapper



Beco Model 410 Drill and Tapper

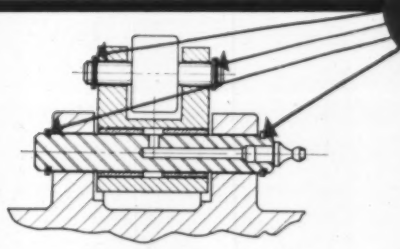
The Batchelder Engineering Co., Inc., Springfield, Vermont uses 4 different sizes of 2 different type Waldes Truarc rings in their new BECO Model 410 Automatic Drill and Tapper. Truarc rings speed assembly, reduce machining, improve design.



ALTERNATE DESIGN TRUARC DESIGN

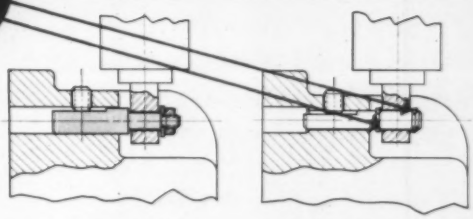
Clamp Cylinder Rod Stop Assembly

Truarc "E" Rings (Series 5133) replace stop nuts in the Clamp Cylinder assembly. They eliminate need for threading 2 rods ...the danger of cross-threading nuts...and costly rejects. Truarc Rings cut assembly time and cost.



Bell Crank Pivot Assembly

Truarc Rings (Series 5100) in Bell Crank Pivot assembly permit grease hole not possible with cotter pin fastener. Use of nuts would have increased machining and assembly costs considerably.



ALTERNATE DESIGN TRUARC DESIGN

Hopper Cylinder Anchor Pin Assembly

2 Truarc Rings (Series 5100) secure and position end of vertical air cylinder. Rings eliminate extra cost of machining 3-diameter pin, threading and undercutting...plus nut and washer. Assembly is quick and sure.

Whatever you make, there's a Waldes Truarc Retaining Ring designed to improve your product...to save you material, machining and labor costs. They're quick and easy to assemble and disassemble, and they do a better job of holding parts together. Truarc rings are precision engineered and precision made, quality controlled from raw material to finished ring.

36 functionally different types...as many as 97 different sizes within a type...5 metal specifications and 14 different finishes. Truarc rings are available from 90 stocking points throughout the U. S. A. and Canada.

More than 30 engineering-minded factory representatives and 700 field men are available to you on call. Send us your blueprints today...let our Truarc engineers help you solve design, assembly and production problems...without obligation.

For precision internal grooving and undercutting...Waldes Truarc Grooving Tool!

WALDES

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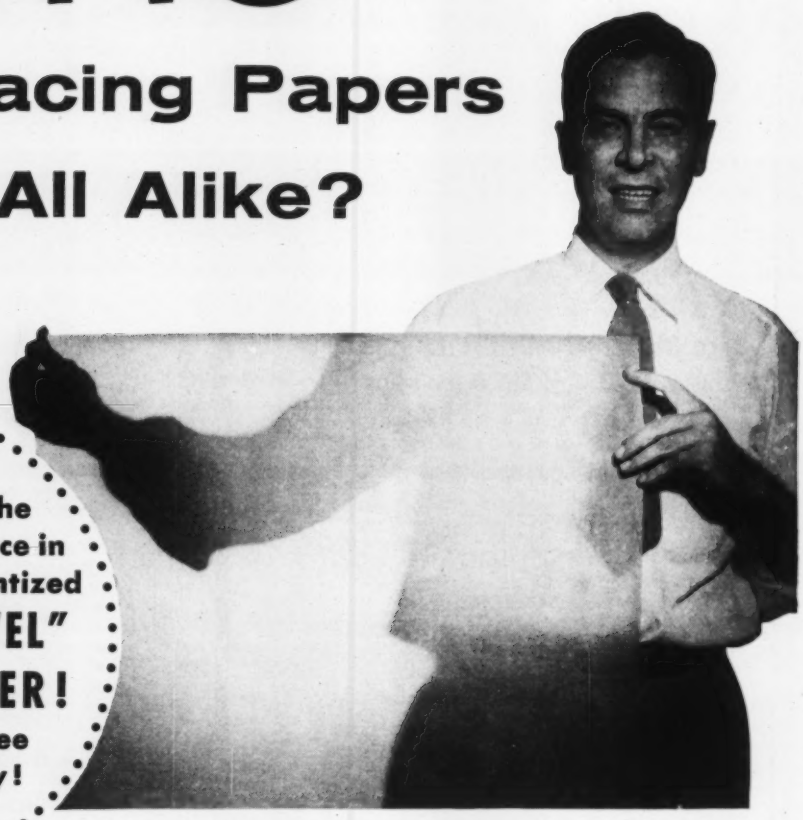
ME 098

WALDES TRUARC Retaining Rings, Grooving Tools, Pliers, Applicators and Dispensers are protected by one or more of the following U. S. Patents: 2,382,948; 2,411,426; 2,411,761; 2,416,852; 2,420,921; 2,428,341; 2,439,785; 2,441,846; 2,455,165; 2,483,379; 2,483,380; 2,483,383; 2,487,802; 2,487,803; 2,491,306; 2,491,310; 2,509,081; 2,544,631; 2,546,616; 2,547,263; 2,558,704; 2,574,034; 2,577,319; 2,595,787, and other U. S. Patents pending. Equal patent protection established in foreign countries.

WHO

Says Tracing Papers Are All Alike?



See for Yourself the Wonderful Difference in Bruning's Transparentized

No. 357 "KOVEL" TRACING PAPER!

Send for Your Free Trial Sheet Today!

Here's a challenge you'll be glad you accepted. Test the tracing paper you're now using against Bruning's general purpose No. 357 "Kovel" Tracing Paper. You'll discover a wonderful difference that will pay off for you in neater, higher quality drawings and cleaner, sharper, faster prints.

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Send for your free trial sheet today. Discover for yourself the big difference, except in price, that has gained "Kovel" acceptance as the finest general purpose tracing paper of its type on the market.

For all the advantages of "Kovel" in a thinner, untinted white paper, try No. 354 "Frenchvel" Tracing Paper. The high translucency of "Frenchvel" makes it ideal for tracing from weak-lined drawings or blueprints and for higher volume reproduction.

And for a Wonderful Difference in a Smooth Surface Paper, try . . .

BRUNING'S No. 350 "VELLUX"

The moment you put pencil, or ink, to this smooth-surface, vellum-type tracing paper, you'll see what a difference quality can make. This permanently white, transparentized paper is unsurpassed for textural uniformity and for fine all-around performance. Prove the difference to yourself by sending today for your free trial sheet.

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Company _____

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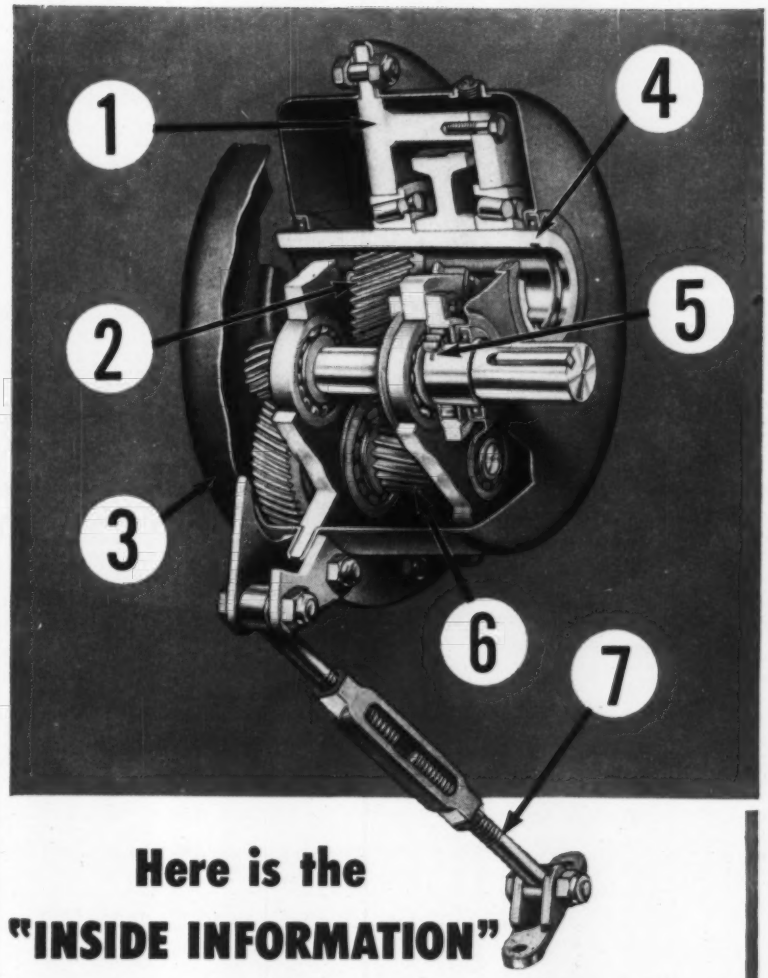


Here is the "INSIDE INFORMATION" on FALK ALL-STEEL Shaft Mounted Drives

Take a careful look inside the Falk all-steel Shaft Mounted Drive, and you will know why this newest member of the famous Falk family is ideal for applications where direct mounting on the driven shaft is desirable. It is the only drive in its field with all these superior "In-built" factors:—

1 **All-steel Frame,** with more than double the rigidity of iron, supports all rotating elements.

2 **Precision Helical Gears,** designed and machined by Falk, rated to AGMA standards.

3 **Pressed Steel Housings,** whose sole function is to keep oil in, dirt out; easily removed for gear inspection without dismounting unit.

4 **Through Hollow Shaft** with counter bore provides for easiest installation or removal from driven machine shaft extensions.

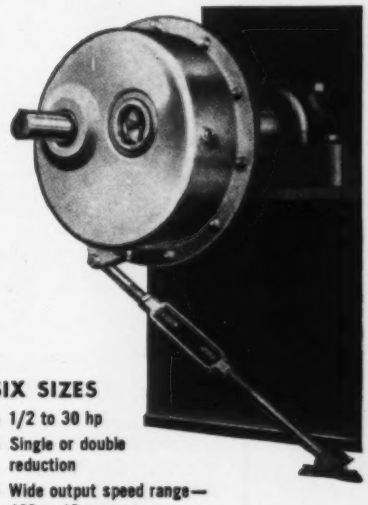
5 **Backstop** can be furnished with the unit or added later for positive prevention of reverse rotation.

6 **Positive Lubrication,** continuous direct dip of revolving elements at all speeds.

7 **Tie Rod** and turnbuckle serve as anchor and facilitate V-belt or chain adjustment.

Write to Department 247 for engineering bulletin, including selection and dimension details.

EFFICIENT SPEED REDUCTION IN LIMITED SPACE

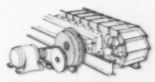


SIX SIZES

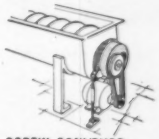
- 1/2 to 30 hp
- Single or double reduction
- Wide output speed range—420 to 10 rpm

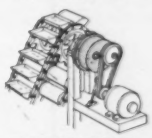
Expressly designed for topflight performance on installations requiring considerable speed reduction in limited space, the all-steel FALK Shaft Mounted Drive has quickly won acceptance throughout industry. This sturdy, compact, versatile reducing unit is an ingenious variation of the highly successful FALK Motoreducer design, pacemaker in its field for more than 20 years. Here, the time-proved design is adapted for mounting directly on the shaft to be driven, using V-belt connection to motor. Investigate now!

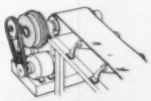
A FEW TYPICAL APPLICATIONS

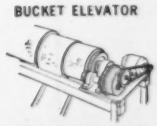

APRON FEEDER

LINE SHAFTING


SCREW CONVEYOR


BUCKET ELEVATOR


BELT CONVEYOR


GRAVEL CLASSIFIER

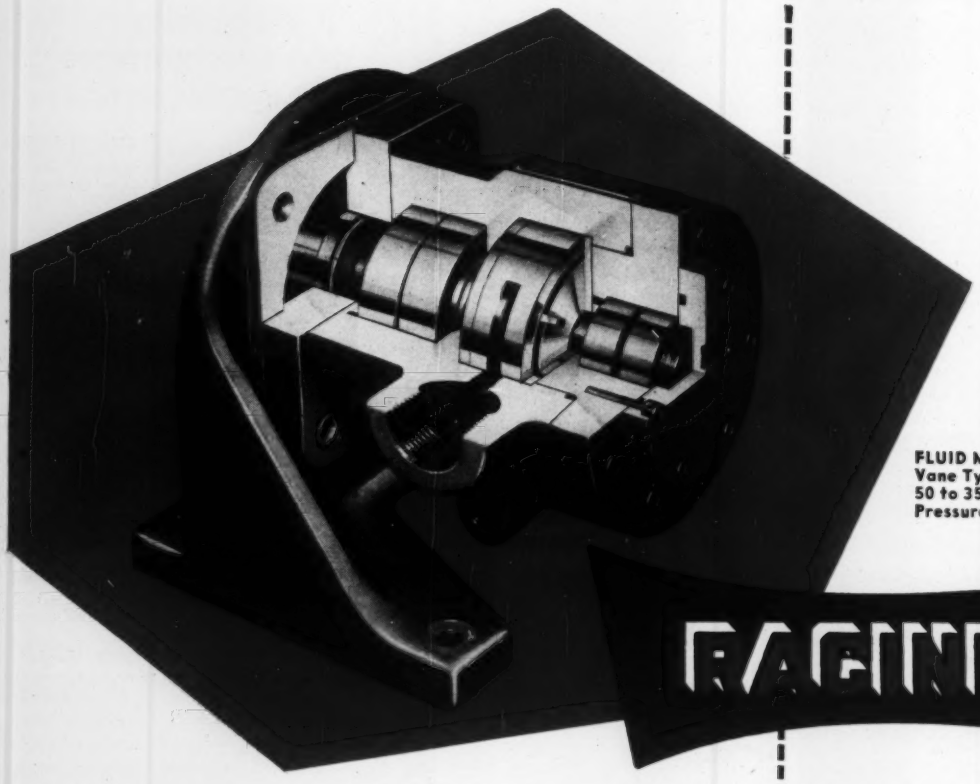
THE FALK CORPORATION, Milwaukee 8, Wisconsin

MANUFACTURERS OF

- Motoreducers
- Speed Reducers
- Flexible Couplings
- Shaft Mounted Drives
- High Speed Drives
- Special Gear Drives
- Single Helical Gears
- Herringbone Gears
- Marine Drives
- Steel Castings
- Weldments
- Contract Machining

FALK

...a good name in industry



FLUID MOTOR
Vane Type
50 to 3500 rpm
Pressures to 1500 psi

RACINE®

A BETTER SOURCE OF ROTARY FORCE

Simple, compact and rugged in design, a RACINE Vane Type FLUID MOTOR transmits efficient hydraulic horsepower.

Note its simplicity and the minimum of moving parts, all of which are self-compensating for wear. Extra capacity bearings, heavy-duty shaft, tool steel vanes and alloy steel rotors, all contribute to efficient, dependable performance and maximum operating life.

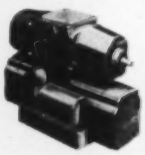
RACINE Vane Type FLUID MOTORS are available in several sizes with maximum output to 22 horsepower. Speeds from 50 to 3500 RPM — operating pressures to 1500 PSI.

Write today for full details. Let us show you why RACINE can give you "A Better Source of Rotary Force."

OTHER RACINE HYDRAULIC PRODUCTS

MODEL Q
Variable Volume
Vane Type
Hydraulic Pump

PRESSURE BOOSTER
Up to 5000 psi
Up to 7:1 pressure ratio



4-WAY VALVE
Twin Solenoid
Pilot Operated

RESERVOIR
With Control Panel
Designed to your space
and circuit requirements

RACINE

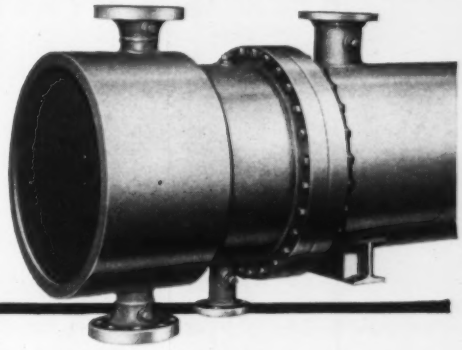
NFPA NATIONAL FLUID POWER ASSOCIATION

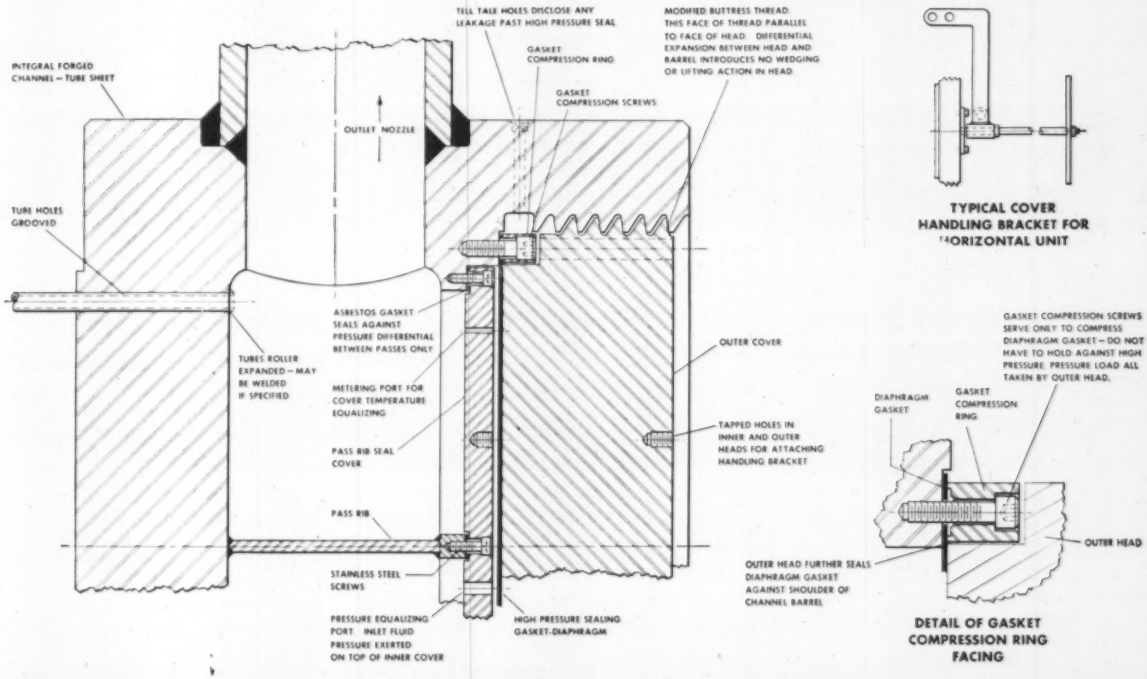
RACINE HYDRAULICS & MACHINERY, INC.
2072 Albert Street
RACINE, WISCONSIN, U. S. A.

INSIDE FACTS

on the simplicity, safety and operating advantages of the exclusive Ross High Pressure Closure Design*

- Simpler design.
- Fewer parts to handle.
- High pressure seal unaffected by hydrostatic loads.
- Greater safety factor.
- Sudden load fluctuations no problem.
- Outer cover cannot corrode and bind . . . easily removed.
- Easily opened for inspection.




TELL TALE HOLES DISCLOSE ANY LEAKAGE PAST HIGH PRESSURE SEAL
MODIFIED BUTTRESS THREAD. THIS FACE OF THREAD PARALLEL TO FACE OF HEAD. DIFFERENTIAL EXPANSION BETWEEN HEAD AND BARREL INTRODUCES NO WEDGING OR LIFTING ACTION IN HEAD.
GASKET COMPRESSION RING
GASKET COMPRESSION SCREWS
INTEGRAL FORGED CHANNEL – TUBE SHEET
OUTLET NOZZLE
TUBE HOLES GROOVED
ASBESTOS GASKET SEALS AGAINST PRESSURE DIFFERENTIAL BETWEEN PASSES ONLY
TUBES ROLLER EXPANDED – MAY BE WELDED IF SPECIFIED
METERING PORT FOR COVER TEMPERATURE EQUALIZING
PASS RIB SEAL COVER
PASS RIB
STAINLESS STEEL SCREWS
PRESSURE EQUALIZING PORT. INLET FLUID PRESSURE EXERTED ON TOP OF INNER COVER
HIGH PRESSURE SEALING GASKET-DIAPHRAGM
OUTER COVER
TAPPED HOLES IN INNER AND OUTER HEADS FOR ATTACHING HANDLING BRACKET
TYPICAL COVER HANDLING BRACKET FOR HORIZONTAL UNIT
GASKET COMPRESSION SCREWS SERVE ONLY TO COMPRESS DIAPHRAGM GASKET – DO NOT HAVE TO HOLD AGAINST HIGH PRESSURE. PRESSURE LOAD ALL TAKEN BY OUTER HEAD.
DIAPHRAGM GASKET
GASKET COMPRESSION RING
OUTER HEAD
OUTER HEAD FURTHER SEALS DIAPHRAGM GASKET AGAINST SHOULDER OF CHANNEL BARREL
DETAIL OF GASKET COMPRESSION RING FACING

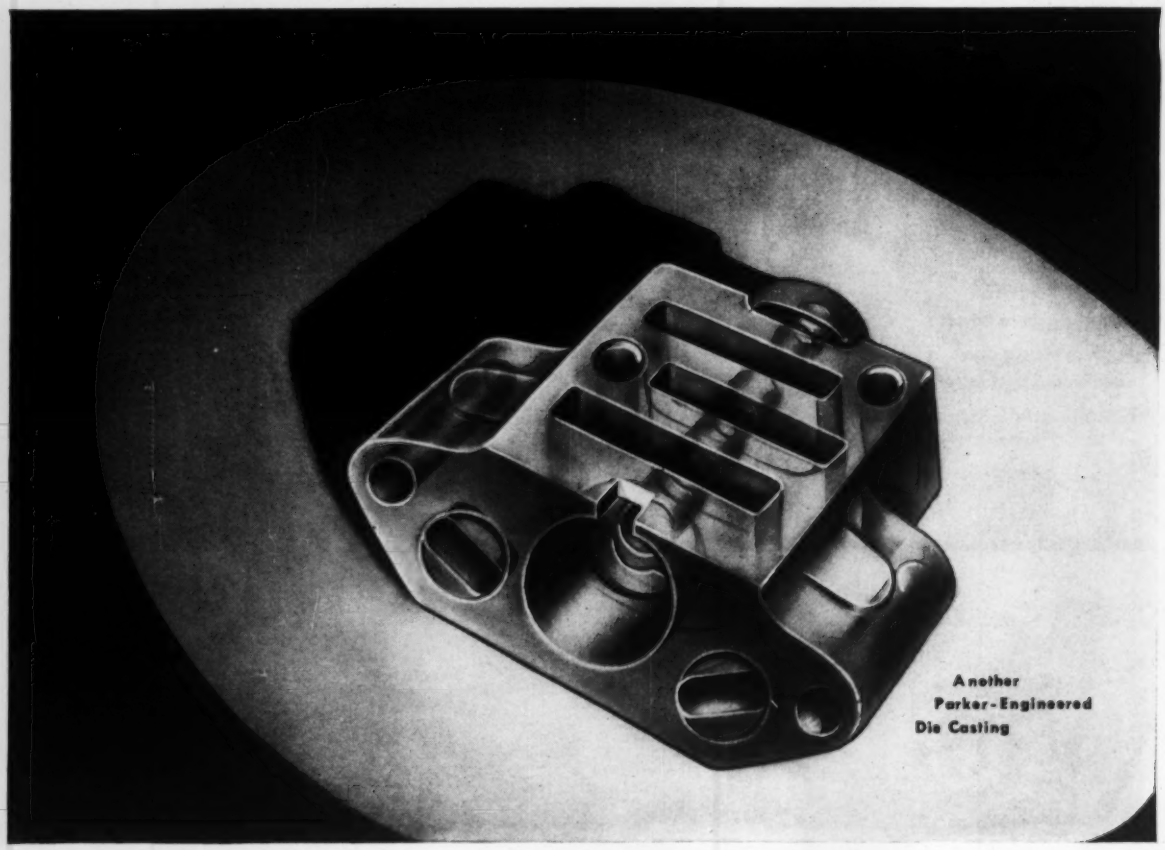
NOW FOR ALL THE DETAILS,

request new Bulletin 5.6K1, mailed immediately. Write Ross Heat Exchanger Division of American-Standard, Buffalo 5, N. Y. In Canada: Kewanee-Ross of Canada Limited, Toronto 5, Ont.

ROSS

ROSS HEAT EXCHANGER PRODUCTS

*for feedwater heaters and other high pressure, high temperature exchangers



Another
Parker-Engineered
Die Casting

HOLES AND ALL . . . In One Casting Operation

PARKER SALES ENGINEERS

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Edward F. Higgins, Jr. • 102 West Adams Street

WILTON, Conn.
Girard L. Palmer • Belden Hill Road

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J. C. Palmer • 712 State Tower Bldg.

BELLEFONTE, Penna.
Warren G. Olson • 420 East Linn Street

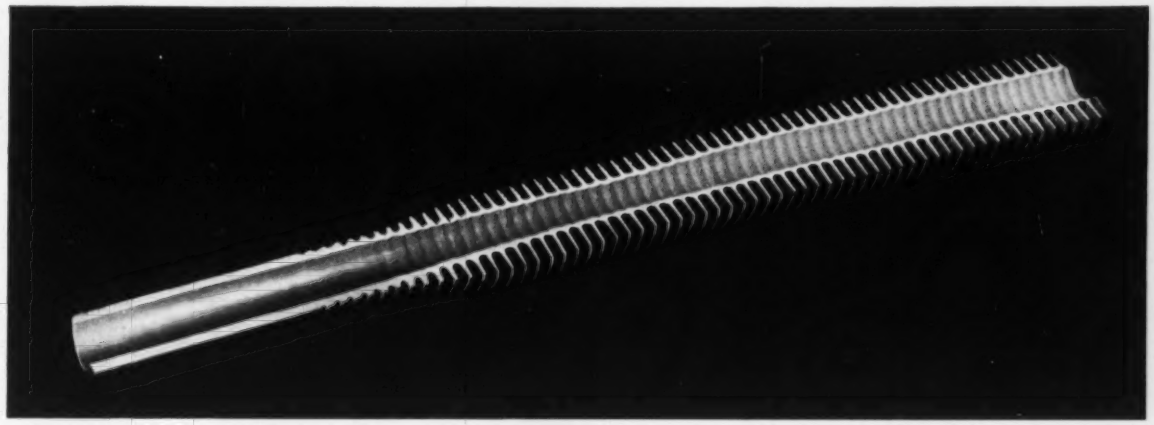
Just imagine the savings effected by producing this intricate part *complete . . .* in *one casting operation.* Here, certainly, is dramatic proof of the skill, experience and creative imagination of Parker die designers. And when you add to these Parker-engineered cost savings other advantages such as high density, smooth as-cast finish and good tensiles, you can see why more and more design engineers are turning to Parker Die Castings for their component parts.

Parker has been a leader in die casting for 50 years—an old hand with new ideas. This skill and experience saves you money on *your* component parts. Just call the nearest Parker sales engineer or write the factory direct.

Parker White Metal Company • 2153 McKinley Ave., Erie, Pennsylvania

PARKER

high pressure
ALUMINUM and ZINC
die castings
POWDERED METAL PARTS



WOLVERINE TRUFIN® The Integral Finned Tube

Wolverine Trufin —Big Step Forward in Heat Transfer

Probably the most significant advance in heat transfer applications came with Wolverine Tube's development of Wolverine Trufin—the integral finned condenser tube.

Trufin is an extended surface tube with fins squeezed directly from the tube wall. Because of this it has more than twice the heat transfer surface of plain tube—extracts more BTU's per foot of tube.

Wolverine Trufin is available in aluminum as well as in copper, copper-base alloys and electric-welded steel. Because its fins are actually part of the tube wall they are unaffected by vibration, temperature changes or pressure variations.

Trufin is available in five distinct types with fins varying in height and number per inch. High finned aluminum Trufin is particularly effective in air-cooled heat transfer applications.

FREE CATALOG BIG HELP TO MANUFACTURERS

A complete description of Wolverine Tube's product line and fabrication facilities is contained in the General Products Catalog. Your request will start it on its way to you without any obligation. Write today!

New Trends Noted:

ALUMINUM TAKES NEW FORM IN WOLVERINE FABRICATION

Today, wherever aluminum is used in the metalworking industry, a new trend is becoming increasingly apparent.

By using the fabrication facilities of supplier firms like Wolverine Tube, many aluminum manufacturers are reducing their production operations and releasing manpower, floor space and equipment for other duties. The net result is a definite saving in time and money plus a real boost in efficiency.

A prime example of Wolverine's fabrication ability is found in its refrigeration evaporator sub-assembly which is proving a real time-saver to busy refrigeration manufacturers. This prefabricated assembly is composed of a bunch-type aluminum coil, a one-piece accumulator (produced in one operation by Wolverine's exclusive Aluminum Spun End Process®) and two copper-to-aluminum connectors.

OTHER WOLVERINE ALUMINUM PRODUCTS

Famed for its Tubemanship, Wolverine Tube produces aluminum tube in a wide range of sizes and alloys in both drawn and extruded form. This rigidly quality controlled product is available in straight lengths, medium length coils and extra long coils.

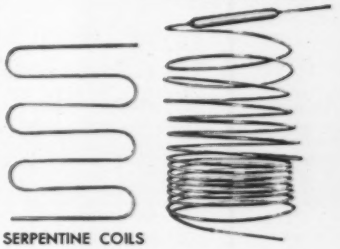
Still another of Wolverine's varied operations is the production of extruded aluminum shapes to customer specifications.

STRAIGHT LENGTHS

Also important is Wolverine's production of aluminum serpentine coils which give a maximum length of tube in small space. Other Wolverine fabrication facilities include finning, coiling, bending, flaring and expanding—to name but a few.

PROCESS PATENT APPLIED FOR

EVAPORATOR COIL



SERPENTINE COILS

DIVISIONS OF CALUMET & HECLA, INC.

CALUMET DIVISION
WOLVERINE TUBE DIVISION
CANADA VULCANIZER & EQUIPMENT CO., LTD.
FOREST INDUSTRIES DIVISION
GOODMAN LUMBER CO.

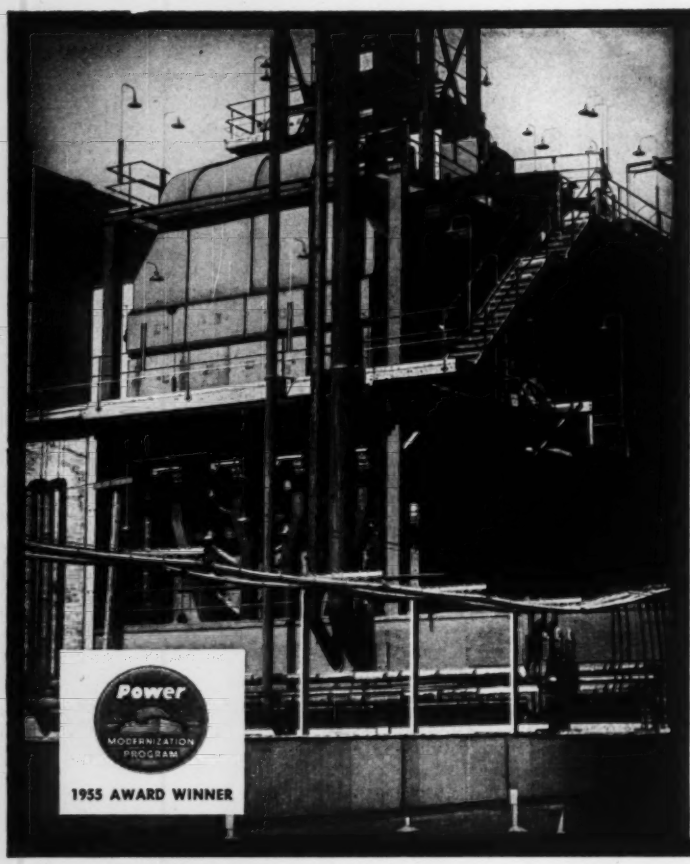
WOLVERINE TUBE

Division of Calumet & Hecla, Inc.
1483 CENTRAL AVENUE, DETROIT 9, MICH.
Manufacturers of Quality Controlled Tubing and Extruded Aluminum Shapes

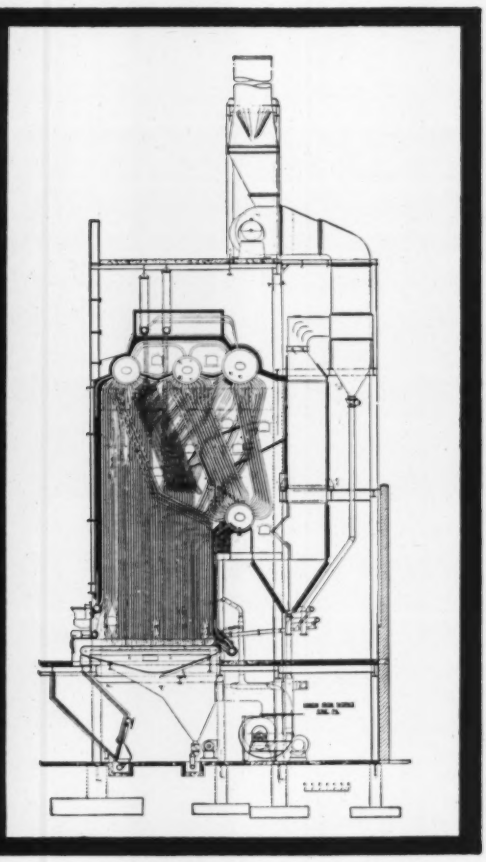
Wolverine Trufin is available in Canada through the Unifin Tube Co., London, Ontario

PLANTS IN DETROIT, MICHIGAN, AND DECATUR, ALABAMA. SALES OFFICES IN PRINCIPAL CITIES.

EXPORT DEPT., 13 E. 40TH ST., NEW YORK 16, N. Y.



John Strange Paper Co., Menasha, Wisconsin



Longitudinal Section of Union Boiler

165,000 lbs/hr Union Boiler plays key role as John Strange wins power modernization award

Named 1955 winner of POWER Magazine's Modernization Award, John Strange Paper Company is ranked with the leaders in its industry on the basis of BTU's used per ton of paper produced.

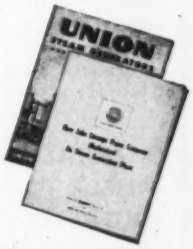
In remodeling its power plant, John Strange followed the recommendations of Cummins and Barnard, Inc. A Union 4-drum boiler was installed to supply steam for both electrical power and processing.

With a steaming capacity of 165,000 lbs/hr at 725 psig and 825° F, this Union semi-outdoor boiler has played a key role in helping boost paper production 10% while saving 29% in fuel costs without increasing plant personnel.

From start to finish, the report "How John Strange Paper Company Modernized Its Steam Generation Plant" is an interesting example of planning power services around a process. It typifies the way in which Union Boilers perform in numerous industrial installations from coast to coast.

GET FULL DETAILS

Both a copy of this story, as it originally appeared in POWER, plus illustrated Catalog GB-153 showing several types of boilers built by Union, will be mailed on request. Write.



UNION

UNION IRON WORKS
ERIE, PENNSYLVANIA

CUT COSTS FROM BARREL TO BEARINGS...

Change lubrication methods from

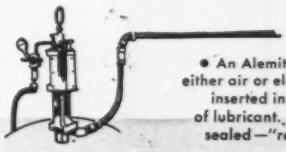
Backward to Forward!

ALEMITE "POWER HOUSE" BARREL PUMP

saves 95 man-hours for every 400-lb. drum of lubricant you use

Lubricating hundreds of bearings by slow, outgrown hand methods is a costly waste of time and money. A modern Alemite "Power House" Barrel Pump does the job much faster—at less cost. You save 95 man-hours for every 400-lb. drum of lubricant used. And because a completely sealed Alemite Barrel Pump system gives cleaner, more efficient lubrication, you make big savings right down the line. Savings in less down-time, and lower maintenance costs . . . in greater efficiency and output.

Air-powered Alemite Barrel Pumps fit directly into either a 400- or 120-lb. drum, send lubricant wherever it is needed anywhere in the plant. Or drum and pump can be placed on a dolly to go right to the machines. You get the big advantage of a completely sealed system. Lubricant reaches bearings "refinery clean"—no mess or waste.



• An Alemite Barrel Pump, either air or electric powered, is inserted in a fresh drum of lubricant. Lubricant is still sealed—"refinery fresh."

• Now the Barrel Pump supplies lubricant, through pipe, anywhere in the plant. Operator simply carries a hose and control valve to outlet, hooks it in, applies lubricant.

• Where piping of lubricant is not practical, power lubrication can be brought right to the machine by simply mounting drum and pump on a dolly.

FREE! New Booklet:
"5 Plans for Better Lubrication"

Alemite, Dept. LL-96, 1850 Diversey Parkway
Chicago 14, Illinois

Please send me my FREE copy of "5 Plans for Better Lubrication."

Name .....

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City ..... Zone ..... State .....

ALEMITE

REG. U. S. PAT. OFF.

BARREL PUMPS

Products of STEWART-WARNER CORPORATION

STEWART SW WARNER

SELECT THE COIL THAT FITS YOUR UNIT-HEATER JOB BEST

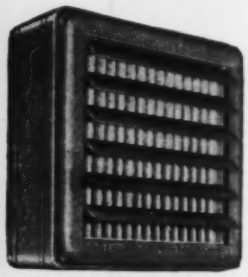
Not only is American Blower's line of Venturafin Unit Heaters complete in all popular sizes and capacities – but you also have a wide choice of coils to fit job requirements.

Both Venturafin Vertical and Horizontal Heaters offer coils for high temperature, high-pressure hot water, or interchangeable coils for steam or low-pressure hot water. An additional hot-water coil of serpentine construction is also available for horizontal heaters for low-pressure hot water.

All coils have high-quality nonferrous fins, mechanically bonded to seamless copper tubes – which, in turn, are brazed to headers. Steel tubes are available for high-temperature, high-pressure hot water.

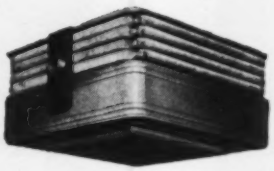
Select low-cost, quiet operating, easy-to-install American Blower Unit Heaters for *your* next job. For data, consult your nearest American Blower Branch Office.

Venturafin Unit Heaters for Steam and Hot Water



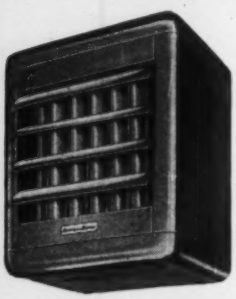
HORIZONTAL HEATERS

For horizontal blow, select from a wide range of capacities: 18,000 to 357,500 BTU at 2 lbs. steam pressure and 60° entering air.



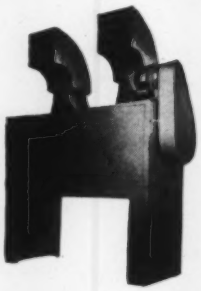
VERTICAL HEATERS

Equipped with exclusive ABC Equitemp Air Diffusers. Capacities: 58,400 to 560,000 BTU at 2 lbs. steam pressure and 60° entering air.



GAS-FIRED HEATERS

Available for natural, mixed, manufactured, LP, LP air gas mixtures, and dual fuel arrangements. Sizes and capacities to fit your needs.



INDUSTRIAL HEATERS

High-velocity type industrial space heating. Seven sizes. Capacities from 79,000 to 1,630,000 BTU per hour. Certified Ratings.

American Blower products serve industry

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CANADIAN SIROCCO COMPANY, LTD., WINDSOR, ONTARIO
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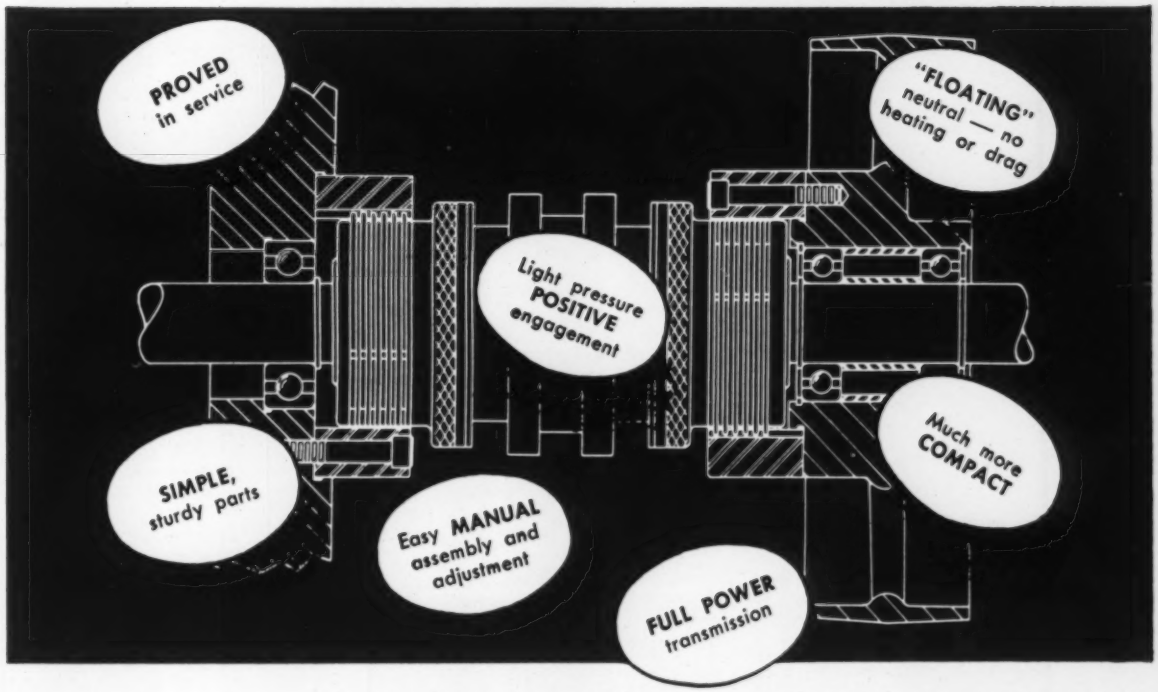
AMERICAN **BLOWER**

ASSURE YOUR PRODUCT THE *PROVED* SUPERIORITY OF A

MAXITORQ
floating disc
CLUTCH


PROVED in service
"FLOATING" neutral — no heating or drag
Light pressure POSITIVE engagement
Much more COMPACT
SIMPLE, sturdy parts
Easy MANUAL assembly and adjustment
FULL POWER transmission

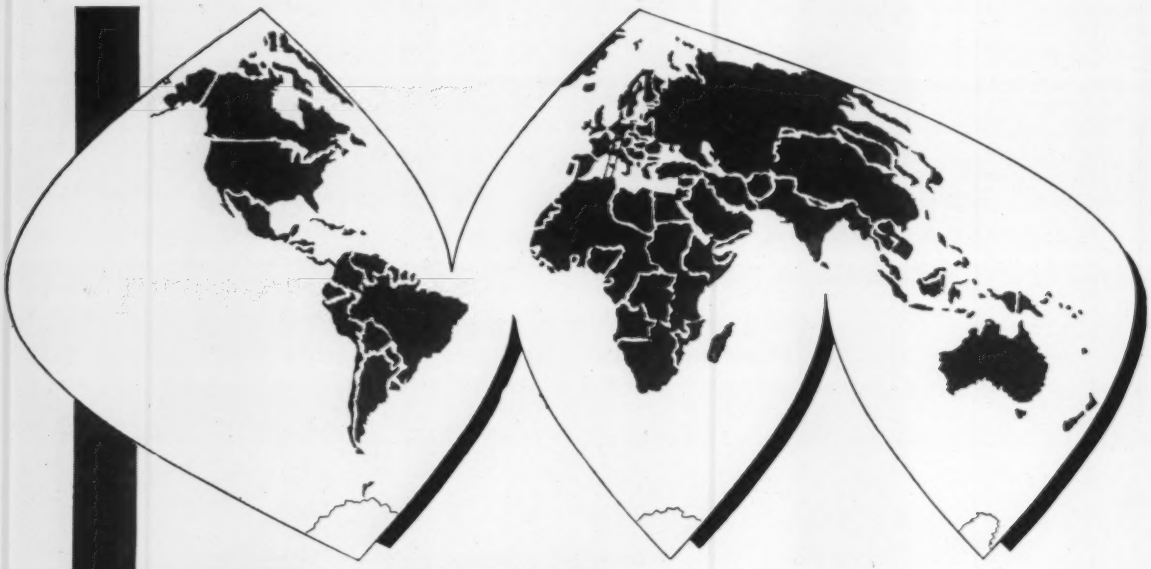
The line drawing shows typical application of a double Maxitorq Floating Disc Clutch, arranged for both drive and brake, with ring-type driving cups.

Such installations have a well-proved record of efficiency and freedom from maintenance. Drive and brake engagement and disengagement are smooth and positive . . . without drag or heating . . . because exclusive MAXITORQ design assures that discs ride free in neutral.

MAXITORQ Floating Disc Clutches are available in a wide range of sizes and types . . . single, double, overload release . . . to meet specific installation demands. Our engineering department also stands ready to help you solve special drive problems. Write or phone Dept. ME-9. The Carlyle Johnson Machine Company, Manchester, Conn.

Let's talk **MAXITORQ**

6CJ55



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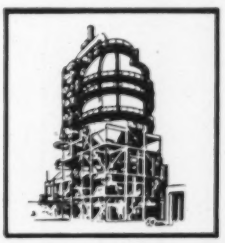

ERECTION SERVICE

If you are revamping or adding to the capacity of cat crackers, oil stills or heaters—you'll do better if you get a quote from Bigelow-Liptak on the refractories for the vessel or heat enclosures.

Why? Because B-L supplies all of the *three* elements which must be considered—engineering, materials, erection help.

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Often seen in Engineers notebooks

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They always meet our specs.

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Will use Illinois Gear as our source. I like their quality and service too!
J. R.

Look for this mark ILG the symbol on finer gears

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LECTRODRYER is the name of a large family of DRYing machines. They DRY air, gases and organic liquids. They range in size from the tiny Laboratory model, capable of handling a few cubic feet per hour, to giant wind tunnel installations DRYing tons of air per minute. They work from atmospheric pressure to as high as 6,000 psi.

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Remember the word LECTRODRYER when you need DRYing help. For a free copy of the book, *Because Moisture Isn't Pink,* write Pittsburgh Lectrodryer Company, 334 32nd Street, Pittsburgh 30, Pa. (a McGraw Electric Company Division).

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In France: Stein et Roubaix, 24 Rue Erlanger, Paris XVI.
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LECTRODRYERS DRY
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LECTRODRYER

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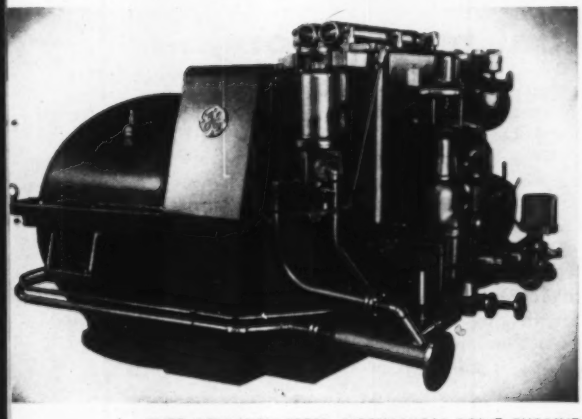
TURBINES FOR
HIGH-SPEED COMPRESSORS

VIBRATION RECORD, inset, is obtained by exciting buckets. Peaks indicate resonant vibration response of buckets. For more reliable operation, G-E engineers confine bucket exciting frequencies to "quiet zones" between the peaks.

How G-E Engineers Locate "Quiet Zones" for Safer High-speed Turbine Operation



TYPE DRV HIGH-SPEED MECHANICAL-DRIVE TURBINE

When driving modern compressors and blowers, G-E high-speed turbines spin at operating speeds of 7000 rpm and up. At such speeds, if resonant vibration were not controlled carefully, bucket fatigue failure might result.

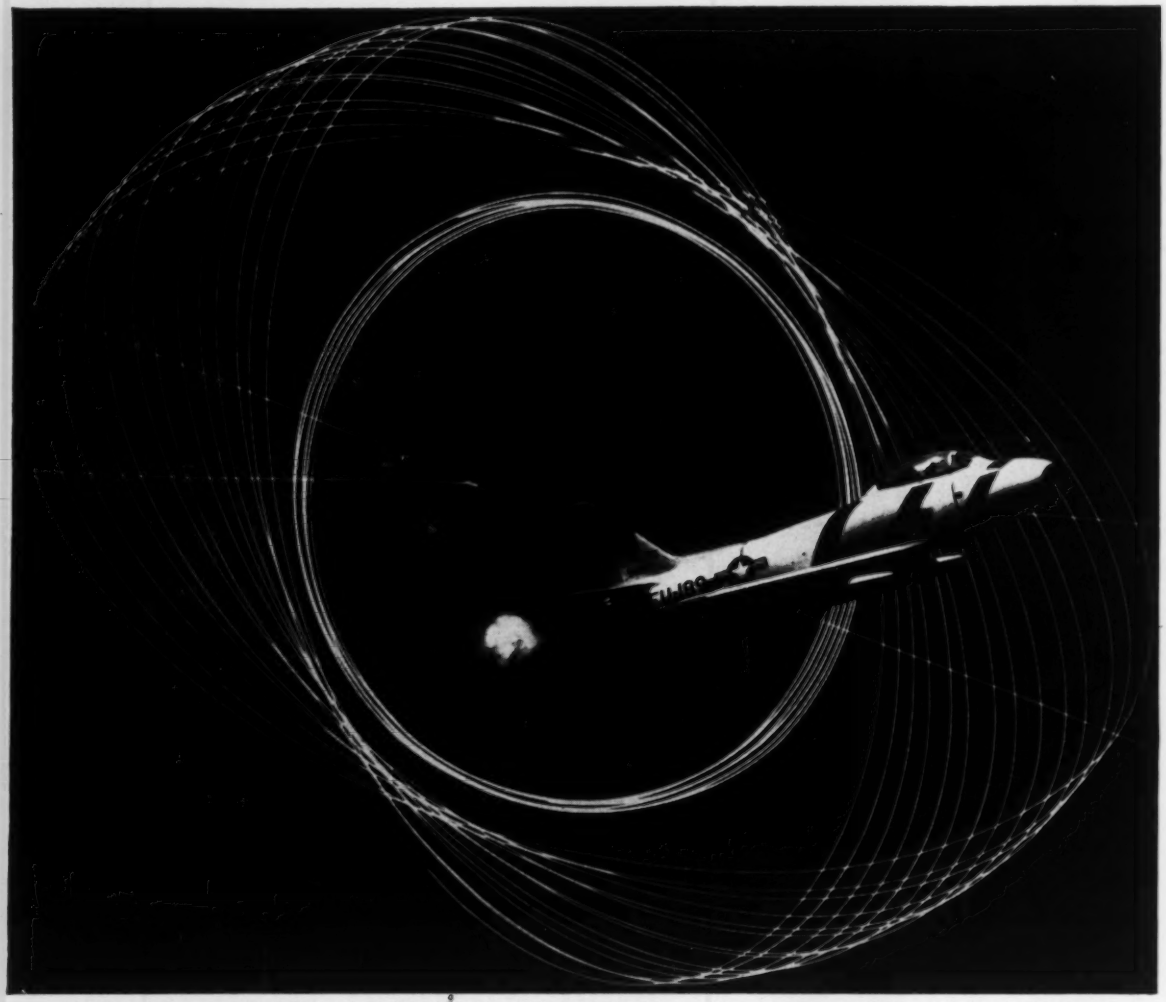
HERE'S HOW General Electric combats the problem: Natural vibration frequencies of the buckets on each new turbine rotor are determined with the special equipment shown above—an oscillator, crystal pick-up, and high-speed level recorder. "Quiet zones" of minimum normal vibration are clearly revealed.

With this information available, the number of nozzles can be varied so that steam striking the buckets will create vibration-exciting frequencies only in these "quiet zones." By thus making sure that steam-impact frequencies don't coincide with critical natural frequencies, the chance of bucket failure is greatly reduced.

VIBRATION TESTING is one of many features that add to the reliability of G-E high-speed turbines. For more information, contact your nearest G-E Apparatus Sales Office or write for Bulletin GEA-6232, General Electric Company, Section 241-2, Schenectady 5, N. Y.

Progress Is Our Most Important Product

GENERAL ELECTRIC



A jet fitted with Autonetics Flight Test equipment shoots smoke puffs from wingtip pods to create aerial markers for checking control systems' accuracy.

Autonetics' "flying laboratories" spearhead electro-mechanical breakthroughs

Before major battles can be won in the development of automatic control systems, much scientific reconnaissance must take place high in the air.

AUTONETICS' Flight Test Section is uniquely equipped to do this job—in all phases of systems development, whether the projects are fresh from the laboratory or in final performance evaluation. Using probably the largest fleet of test vehicles in the industry, Flight Test experts extend AUTONETICS' engineering into the elements... at altitudes, speeds and extreme conditions that are dress rehearsals of possible future situations.

Keeping accurate, automatic records of systems performance during these live tests is another great challenge. Since the best available recording equipment is usually less accurate than the system being tested, extraordinary custom-engineering is required. For example, normal instrumentation recording setups usually contain a percentage of error, and the data on these systems must be gathered to such accuracy that new and specialized techniques and equipment are necessary. These electronic refinements are designed and built right on the spot at AUTONETICS' Flight Test, assuring hitherto unknown degrees of precision.

In 10 years AUTONETICS has achieved full capability in research, development, design, manufacture and test of complete systems in information processing, inertial navigation, flight controls, weapons director controls, computers and other special products.

For more detailed information, or for employment in any one of these fields, please write: AUTONETICS, Dept. ME-N4, 12214 Lakewood Blvd., Downey, California.

Autonetics

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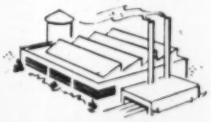
AUTOMATIC CONTROLS MAN HAS NEVER BUILT BEFORE

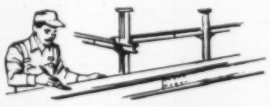


PROVED THROUGHOUT INDUSTRY FOR OVER THIRTY YEARS

Industrial leaders all over the world have used Rust-Oleum to stop and prevent rust for over thirty years. Rust-Oleum can do the same for your tanks, stacks, pipes, machinery, metal sash, wire fences, girders, etc.

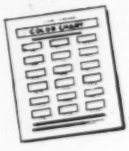
RUST-OLEUM IS EXCLUSIVE

Rust-Oleum uses a specially-processed fish oil vehicle that penetrates rust to bare metal, dries right, and is free from objectionable odor. Accept no substitutes. Buy—and specify Rust-Oleum. You'll be happy that you did. There is only one Rust-Oleum—it is distinctive as your own fingerprint.



APPLY DIRECTLY OVER RUSTED SURFACES

Just scrape and wirebrush to remove rust scale and loose rust—then brush Rust-Oleum 769 Damp-Proof Red Primer right over the remaining rust, usually eliminating costly surface preparations. Then—follow-up with your desired Rust-Oleum finish color.

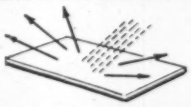


MANY COLORS, INCLUDING ALUMINUM AND WHITE

You beautify as you protect, because Rust-Oleum finish coatings are available in practically all colors, including aluminum and white. They use the same basic rust-inhibiting vehicle as Rust-Oleum 769 Damp-Proof Red Primer and so provide double protection.

GREATER COVERAGE—EASY TO USE

Rust-Oleum is so easy to apply by brush or spray that one man can often do the work of two. Because of Rust-Oleum's easy-flowing qualities, an average of 30% more coverage is usually received—depending upon the type and porosity of the surface.



PRACTICAL ANSWER TO YOUR RUST-PRODUCING CONDITIONS

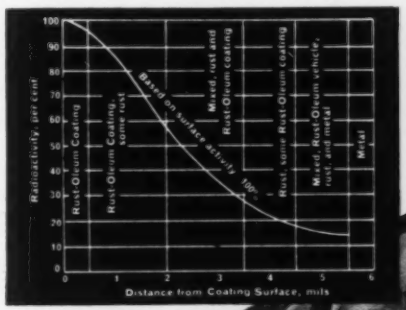
Rust-Oleum dries to a firm, decorative finish that resists salt water, heat, fumes, sun, steam, humidity, and weathering. Whatever your rust problem—you'll find Rust-Oleum the modern, practical way to stop rust.

Facts

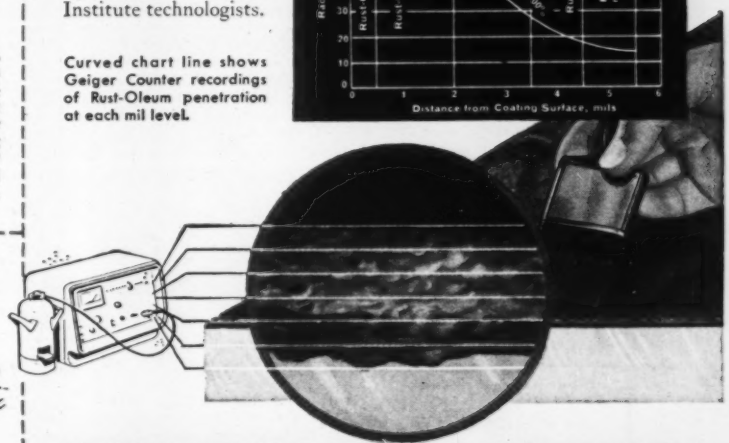
prove the economy of

RUST-OLEUM®

Geiger Counter traces Rust-Oleum penetration through rust to bare metal. The results of radioactive research prove that Rust-Oleum penetrates rust to bare metal. Rust-Oleum's *specially-processed* fish oil vehicle was radioactivated and formulated into Rust-Oleum 769 Damp-Proof Red Primer—then applied to rusted test panels. Geiger Counters then traced Rust-Oleum's *specially-processed* fish oil vehicle through the rust to bare metal. This penetration enables Rust-Oleum to be applied directly over sound rusted surfaces—usually eliminating costly surface preparations. Attach coupon to your business letterhead for your thirty-page report, "The Development of a Method To Determine The Degree of Penetration of a Rust-Oleum Fish-Oil-Based Coating Into Rust On Steel Specimens," prepared by Battelle Memorial Institute technologists.



Curved chart line shows Geiger Counter recordings of Rust-Oleum penetration at each mil level.



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Graduate Electrical Engineers for the development of control systems for Atomic Power reactors. General control experience in power station, aircraft, marine vessels, or automatic machinery desirable. Broad responsibility from specifications to installation and operation.

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Plant located in one of the most desirable suburban Pittsburgh communities. Applicants who meet our requirements will be invited to visit us at our expense.

Send complete resume to:
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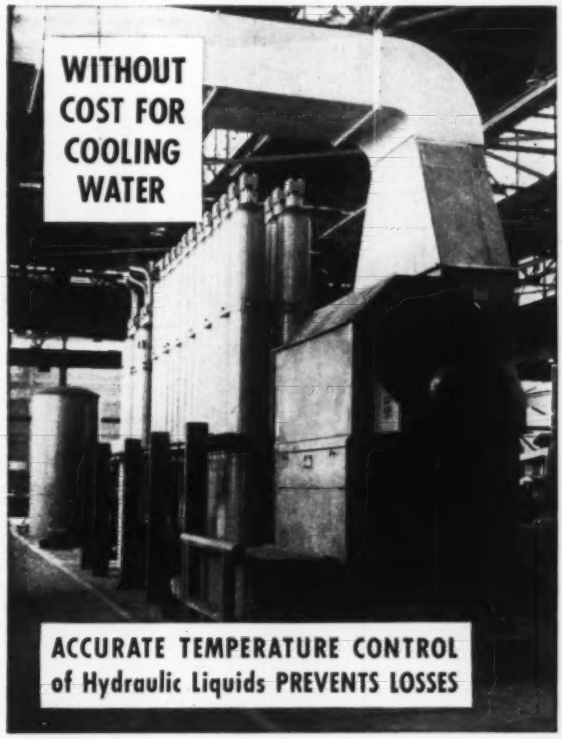

● This NIAGARA AERO HEAT EXCHANGER cools the liquid for a large hydraulic press, preventing heat damage to the pump stuffing boxes. Using outdoor air as the evaporative cooling medium, it removes the heat at the rate of input (1,875,000 BTU/hr.) with no cooling water consumption except a negligible amount evaporated.

Air is free and cheaper to move than water. You can save much expense in pumping, piping and power, and quickly recover the equipment cost from the water saving.

Similar Niagara machines cool water, oils, solutions, lubricants and coolants for many mechanical, electrical and chemical processes. You can cool quench baths, welding machines, plastic molds, furnaces, controlled atmospheres, gases, compressed air either for power or instruments or processes. In a closed system, your coolant is never contaminated. The system is simple and easy to keep up; the equipment has a long, useful life. Select from a wide range of sizes up to 30,000,000 BTU.

Write for Bulletin 120 to obtain a complete description.

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3	Bronze Race and Chrome Moly Steel Ball	For types operating under normal loads with minimum friction requirements.

Thousands in use. Backed by years of service life. Wide variety of Plain Types in bore sizes 3/16" to 6" Dia. Rod end types in similar size range with externally or internally threaded shanks. Our Engineers welcome an opportunity of studying individual requirements and prescribing a type or types which will serve under your demanding conditions. Southwest can design special types to fit individual specifications. As a result of thorough study of different operating conditions, various steel alloys have been used to meet specific needs. Write for revised Engineering Manual describing complete line. Dept. ME-56

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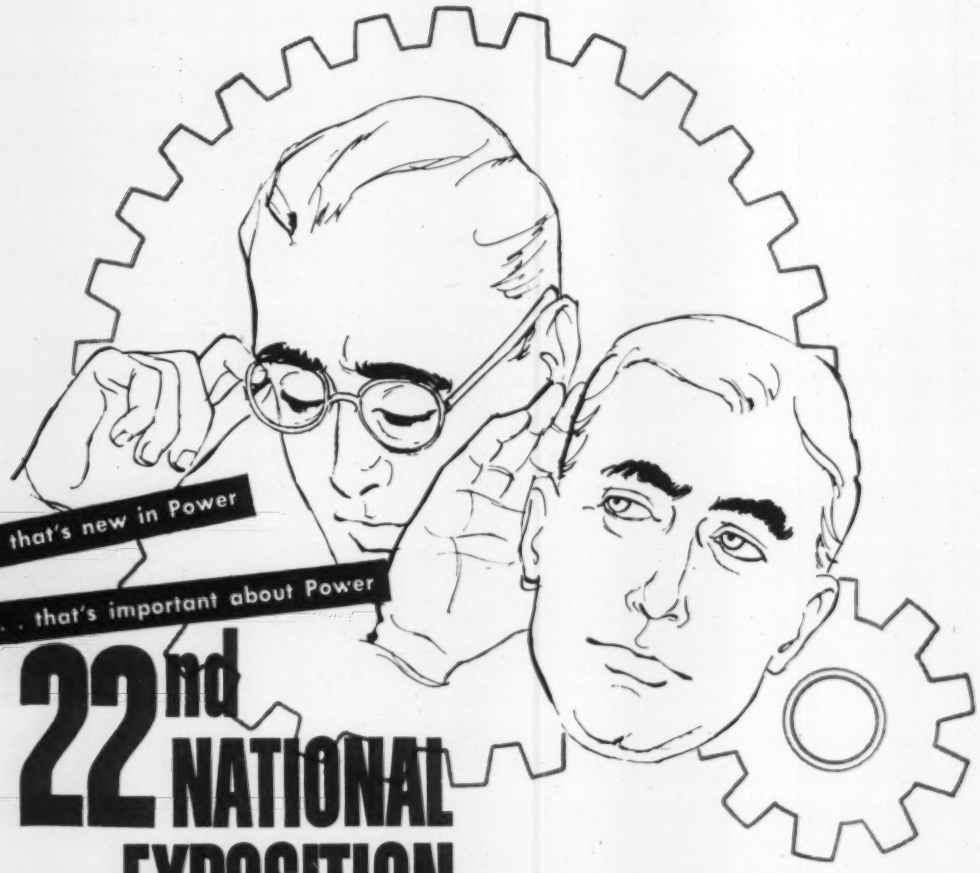
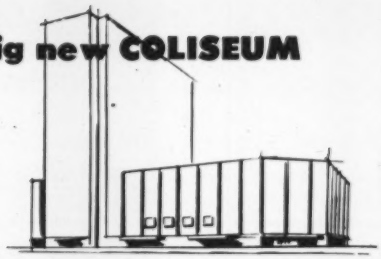


22nd NATIONAL EXPOSITION of POWER & MECHANICAL ENGINEERING

Under auspices of ASME

Nov. 26-30, 1956, In New York's big new COLISEUM



What's new in the field of power? Plenty, and here's where you'll find out about it—at the biggest Power Show of them all in the newest showplace of them all—New York's Coliseum.

Efficient production and use of Power? Hundreds of up-to-the-minute absorbing exhibits will show you what's new and answer your questions, help solve your special problems. You'll meet with scores of men with the same interests, you'll exchange information, you'll get vital new ideas. If your interest is Atomic Energy, you'll find a whole section devoted to this subject.

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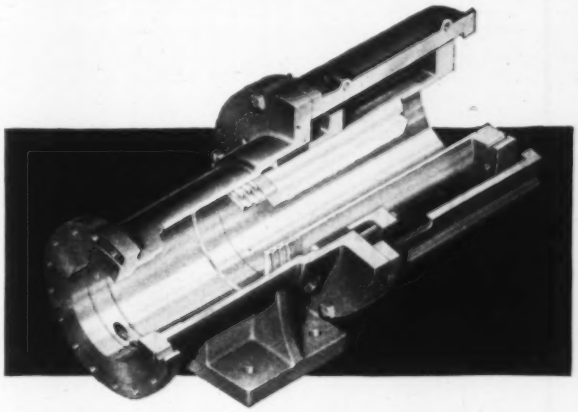
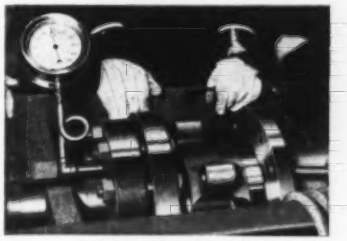
ADSCO

PISTON-RING EXPANSION JOINTS

can be unpacked at full operating pressure



PROOF FROM THE PITTSBURGH TESTING LABORATORY



All packing has been removed. There is no trace of steam in the empty stuffing box, even though steam in the line is at 240 lbs. with 700 F total temperature.

● For simple maintenance, a new ring of packing can be added to an ADSCO Piston-Ring Slip-Type Expansion Joint, but when the old packing has been allowed to become scored, it should be removed and replaced with fresh packing. The ADSCO Piston-Ring Joint is the only joint in the world in which this can be accomplished without shutting off line pressure. With the vent valve open, piston rings hold the line pressure while the joint is being serviced as in photograph at left.

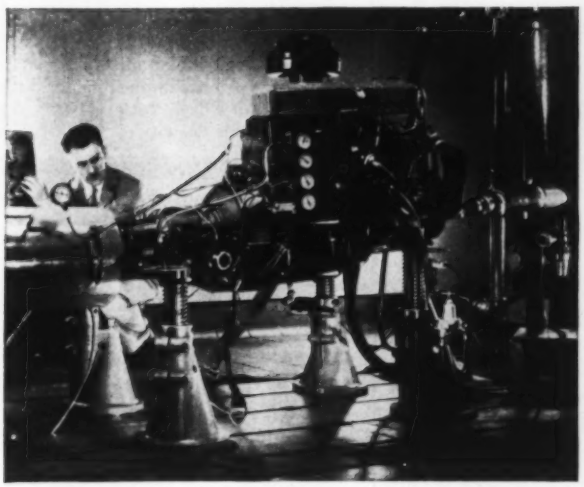
Other features: The slip is continuously guided at its extreme ends throughout its entire length of travel. Primary and secondary limit stops prevent the slip from being pulled out of the body. Openings in the external guide provide easy access to the packing gland for adjustment. The external guide is built in halves to reduce the size of manholes required in underground construction.

These ADSCO Piston-Ring Joints are available in both single and double types, in full range of sizes, with 4", 8", and 12" traverse per slip, and for temperatures to 800 F and higher.

● *Write for Bulletin 56-20.*

AMERICAN DISTRICT STEAM DIVISION
ADSCO INDUSTRIES, INC.
20 MILBURN ST. BUFFALO 12, N. Y.

Improve testing and quality control with Lake Shore base plates



Manufacturers of precision parts and assemblies depend on Lake Shore base plates and dynamometer bases for maintaining quality control and testing standards. Lake Shore plates, made of flaw-free "Lakenite" iron, are machined, ground, or hand scraped to meet your strictest tolerance requirements. For details and specifications on the complete line of Lake Shore plates, send for your free copy of the new illustrated base plate booklet.

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LAKE SHORE, Inc.
Lake Shore Engineering Division
IRON MOUNTAIN 9, MICHIGAN

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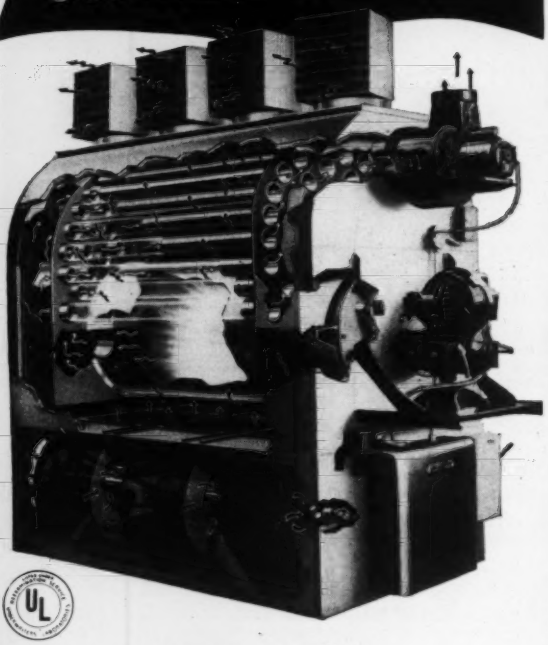

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300,000 BTU's

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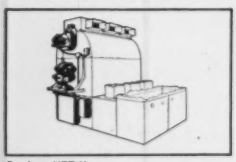
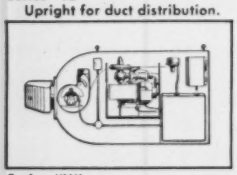
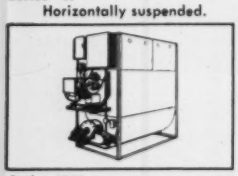


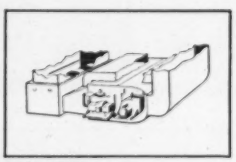
Series "FD"
Upright for duct distribution.



Series "H"
Horizontally suspended.



Series "U"
Inverted suspended.



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A growth opportunity—and a challenge—in a dynamic organization devoted entirely to advanced research and development in missiles field. Openings at all levels.

Small-company opportunity to work closely with associates who are recognized as top men in their field. Large-company stability.

Usual benefits in unusual degree. Living and educational advantages in a suburban vacationland.

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Openings for Supervisor, Experimental Heat Transfer Group, and Engineers, both Senior and Junior levels, for applied research studies in Advanced Missile program of top priority. The work will include design of laboratory equipment used to study missile cooling and/or analysis of laboratory data with application for improved missile design.

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combine the scientific skills, and production facilities of 3 divisions of Avco Manufacturing Corp.: Research and Advanced Development; Crosley; Lycoming—to produce power plants, electronics, airframe components, and precision parts

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with DeZURIK AUTOMATIC CONTROL VALVES!

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Freedom from friction permits DeZurik Automatic Control Valves to respond *instantly* to required changes in valve settings. Regardless of the flow, from gases to slurries—*including high vacuum services*—they operate with top efficiency.

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feature:

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AND they're attractively priced!

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Factories: Indianapolis 8, Ind. and Los Angeles 31, Calif., ***Offices:*** New York; Indianapolis, Chicago, St. Louis, Atlanta, Lubbock and Plainview, Texas; Fresno, Los Angeles, Phoenix, Albuquerque. Consult Your Local Telephone Directory.

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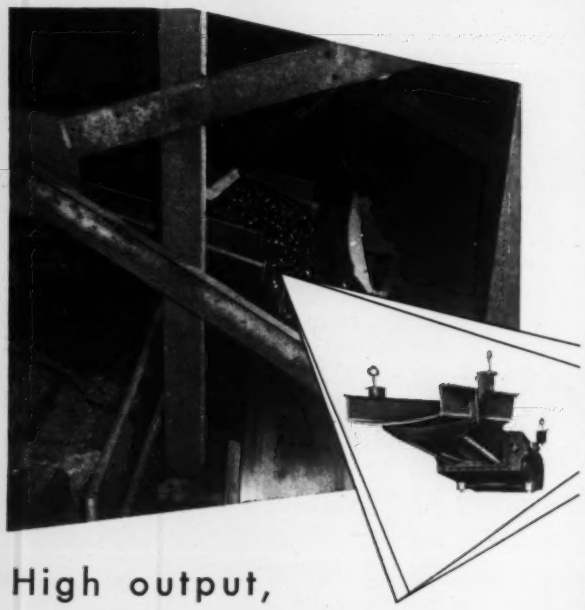

High output, continuous operation

Syntron Vibratory Feeders are especially adaptable for use in automatic batch weighing systems, weigh and packing machines, bag and drum filling and weighing, etc. By providing the simplest and easiest means for controlling its rate of feed Syntron Feeders handle almost every kind of materials. Its rated capacity can be utilized to maintain high production schedules. Syntron Vibra-Flow Feeders use the simple electromagnetic principle which assures long dependable service and maintenance economy.

Other SYNTRON Equipment of proven dependable Quality

ELECTRIC HEATING ELEMENTS

Flat thin strip design. Full heat in a few seconds. Maximum heat contact-uniform distribution. In any required shape.

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Assure a free flow of even the most stubborn materials through hoppers, bins, and chutes. No arching or plugging. Rheostat controlled vibrations.

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Most efficient units yet developed for industrial baking, heating and drying. They heat by direct radiation—not by reflection—no blind spots.

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INDUSTRIAL • CHEMICAL • AIRCRAFT

OFFSET GLOBE VALVE

NEEDLE AND GLOBE TYPES WITH J.I.C. AND AN STANDARD TUBE ENDS

High pressure needle and globe valves by Republic have forged bodies for super duty service—brass, steel, aluminum alloy, or stainless steel. Exclusive design features. Pipe, or AN or J.I.C. tube ends, or combinations, sizes ⅛" to 2". Operating range up to 5,000 psi, −65° to 350°F.

Manufacturers also of high quality low and hy-pressure check valves, relief, 2, 3, and 4-way plug valves, and special valves to specifications.

Write for complete new catalog No. 654A. Distributors in principal cities coast to coast.

191

RM **REPUBLIC MANUFACTURING CO.**
15655 BROOKPARK ROAD • CLEVELAND 11, OHIO

TWO Speed Sensitive SWITCHES

MODEL GH-2

The Synchro-Start Model GH-2 governor contains two snap action switches to be used for opening or closing circuits at any RPM over 500 and is for standard SAE tachometer cable drives. They contain sealed ball bearings, are adjustable while running, and are encased in a splash proof housing. These two switch governors are also supplied for a standard distributor take-off and for AND20005 engine pad mounting (GA Series).

Diameter 2 19/32"—Length 6"—Weight 1¾ lbs.

Other Synchro-Start governors are available with one and three switches together with a variation of mountings.

Write for further information

SYNCHRO-START PRODUCTS
INCORPORATED
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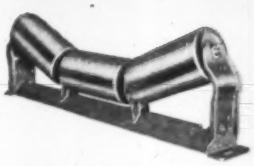

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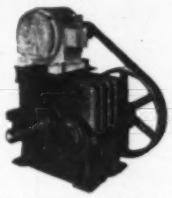
Write for Bulletins 355 and 1454-A



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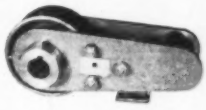

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WRITE TODAY for Catalog No. 60 . . . contains comprehensive data on the complete line of "cost-saving" S-A Standard Industrial Products.

STANDARD PRODUCTS DIVISION

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Henry IV, Part I, Act II, Scene 3

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And yet this very danger is a source of freedom's strength. Time and again, free people have boldly faced dangers that threatened to destroy them, and in so doing found the strength to survive.

For many things seem to flourish best in an atmosphere of embattled freedom . . . ideas and energies, will and determination, even the men and machines that make it possible for freedom to exist and thrive.

This, in a very real sense, underlies our job at Sandia Corporation. At Sandia Laboratory in Albuquerque, N. M. and at our branch installation at Livermore, Cal., we probe new dimensions of research and development engineering to help provide the strength that keeps us free. Specifically, our task is design and development of nuclear weapons that deter aggression and guard our freedom.

Exploration of advanced problems in this challenging and important field provides outstanding career opportunities for engineers and scientists. We are currently seeking additional professional staff members, and will welcome the opportunity to send you more information.

Please address inquiries to

STAFF EMPLOYMENT DIVISION 553A.

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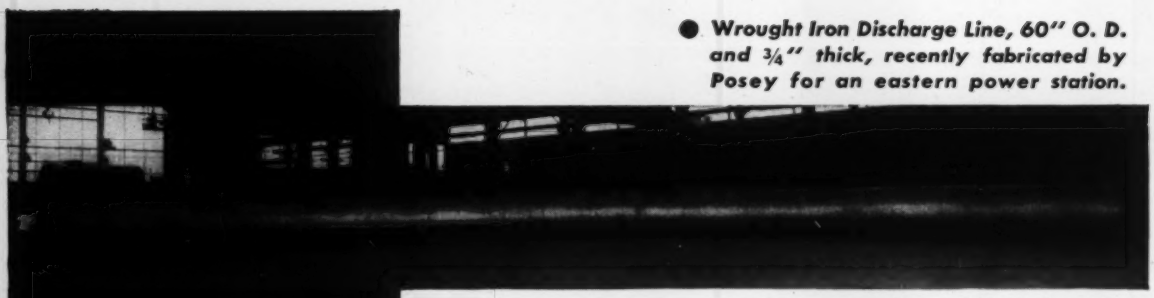
● **Wrought Iron Discharge Line, 60" O. D. and ¾" thick, recently fabricated by Posey for an eastern power station.**



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For Large O. D. WROUGHT IRON PIPE

For Sewage Outfall Lines, Water Intake Lines and Other Specialized Requirements

You can depend on Posey to meet your requirements in large O. D. wrought iron pipe . . . and you can depend on Posey to turn out your job economically and on time.

● *Posey Wrought Iron Pipe is fabricated from plates conforming with ASTM Specifications, Class A 42-52 T.*

● *Posey specializes in large O. D. Pipe and Pilings of wrought iron, carbon steel, low and high alloy steel and alloy clad steel.*

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Every year, more than 15,000 Mechanical Engineers ask for and receive their copy of MECHANICAL CATALOG. They find it an indispensable aid for locating thousands of different items.

It is the only Directory of its kind in industry . . . yet it is made available at no cost by ASME to members.

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Mechanical Catalog
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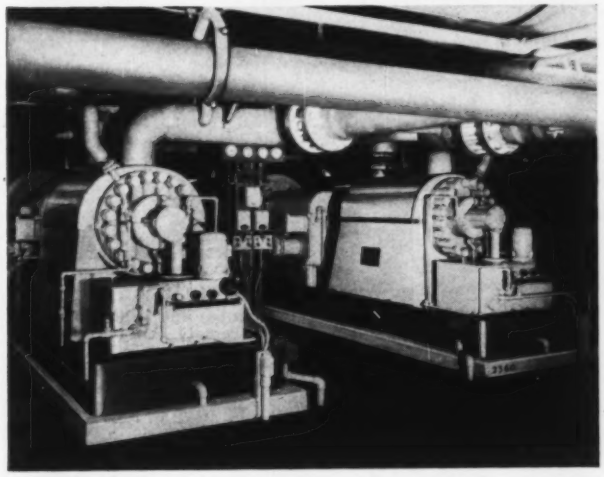
Keeping up with the Kilowatts

PACIFIC BOILER FEED PUMPS FOR ELECTRIC UTILITY SERVICE

▲ Two Typical Pacific Boiler Feed Pump Installations ▼



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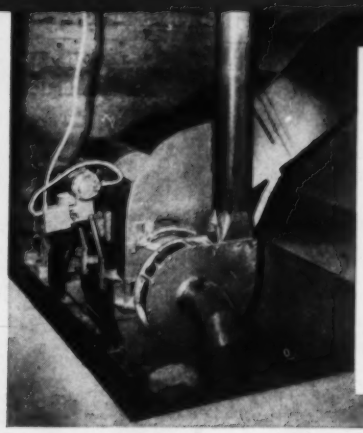
HOW USS "T-1" STEEL IMPROVES THESE PRODUCTS...

Lower-Cost Dirt

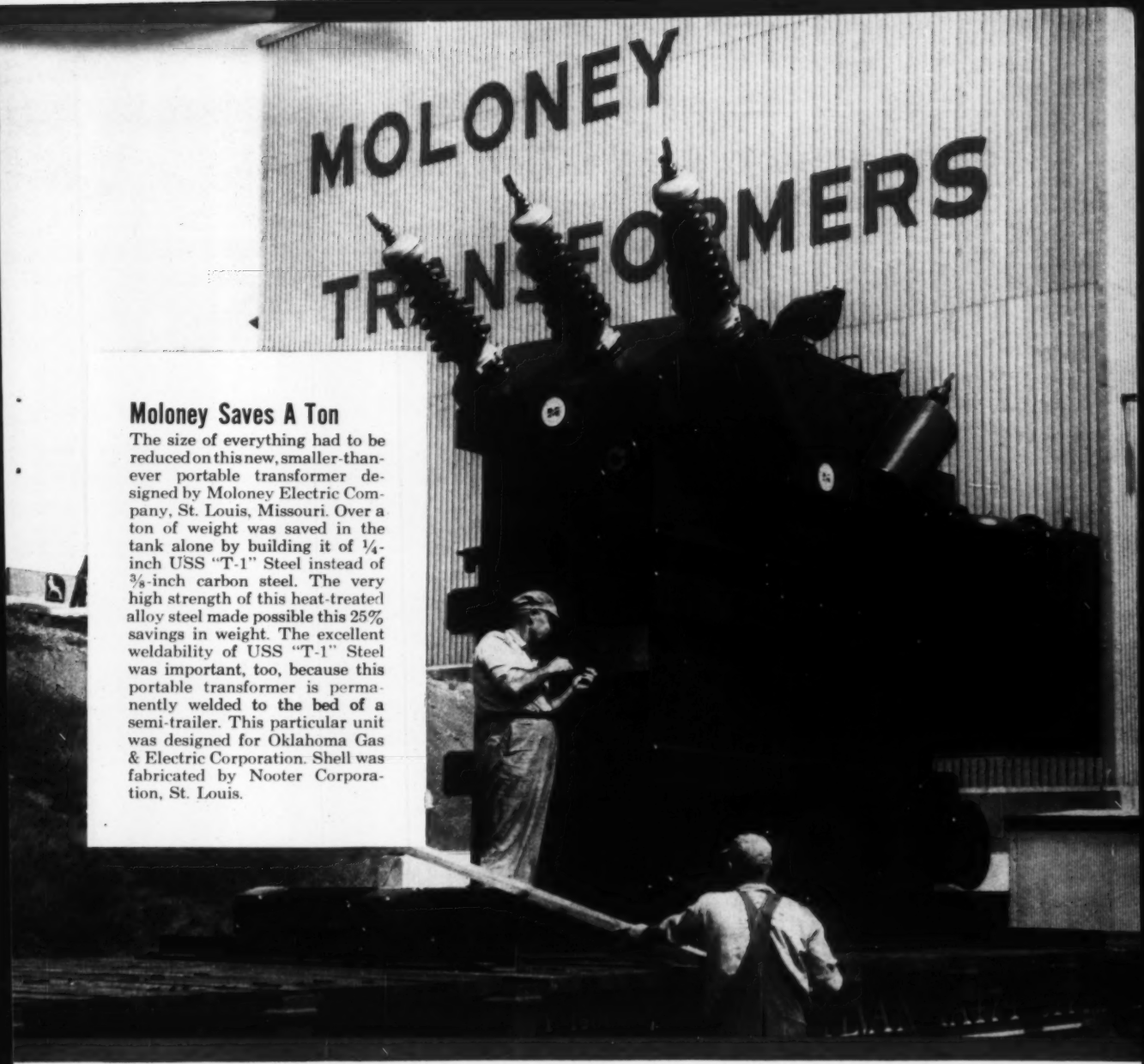
This mammoth coal stripping machine scoops out 2000 yds. of overburden an hour, cuts the cost of stripping coal that lies under 50 to 80 ft. of overburden. Its 22-ft. wheel carries eight buckets, each 4 ft. wide, with lips of 2½-inch USS "T-1" Steel. USS "T-1" Steel has the strength and toughness to scrape through shale, rock, mud, and ram into ton-and-a-half boulders day in and day out. In addition, it is weldable in the field, costs less than other steels that could be used—and outlasts them. This wheel excavator was designed by United Electric Coal Companies, Chicago, for their own use.



Shucks, hay fodder, corn cobs, and grains are extremely abrasive when sucked out of a hammermill at high speed. And the blades of the fan that does the sucking must withstand the abrasion and be weldable. Myers-Sherman Company, Streator, Illinois, manufacturers of industrial hammermills, switched to USS "T-1" Steel and saved $7 on fabrication of each fan.

Heavier Loads, More Production

Mack Welding Company, Duluth, Minnesota, has used "T-1" Steel to increase the durability and at the same time reduce the weight of its Orange Peel Type, Four Tine Pulpwood Grapples. With these new, lightweight grapples, crane operators can handle increased payloads with present cranes. As a result, production can be increased as much as 40 percent.



Moloney Saves A Ton

The size of everything had to be reduced on this new, smaller-than-ever portable transformer designed by Moloney Electric Company, St. Louis, Missouri. Over a ton of weight was saved in the tank alone by building it of ¼-inch USS "T-1" Steel instead of ⅜-inch carbon steel. The very high strength of this heat-treated alloy steel made possible this 25% savings in weight. The excellent weldability of USS "T-1" Steel was important, too, because this portable transformer is permanently welded to the bed of a semi-trailer. This particular unit was designed for Oklahoma Gas & Electric Corporation. Shell was fabricated by Nooter Corporation, St. Louis.

HOW IT CAN HELP YOU

USS "T-1" Steel, with its high minimum yield strength of 90,000 psi and its minimum tensile strength of 105,000 psi, can help you design or build lighter-weight equipment that will last longer. Its unusual toughness can help you design or build equipment capable of taking severe impact and abuse at sub-zero temperatures. Its excellent weldability can help you cut the cost of fabricating high strength parts, and reduce repair and maintenance expense. Its good creep rupture strength can help you put more durability in equipment that operates at temperatures as high as 900 degrees F.

Somewhere in your operation, versatile USS "T-1" Steel can help you. Write, wire, or phone United States Steel, Room 5394, Pittsburgh 30, Pa.

UNITED STATES STEEL CORPORATION, PITTSBURGH · COLUMBIA-GENEVA STEEL DIVISION, SAN FRANCISCO · TENNESSEE COAL & IRON DIVISION, FAIRFIELD, ALA.
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USS "T1" CONSTRUCTIONAL ALLOY STEEL

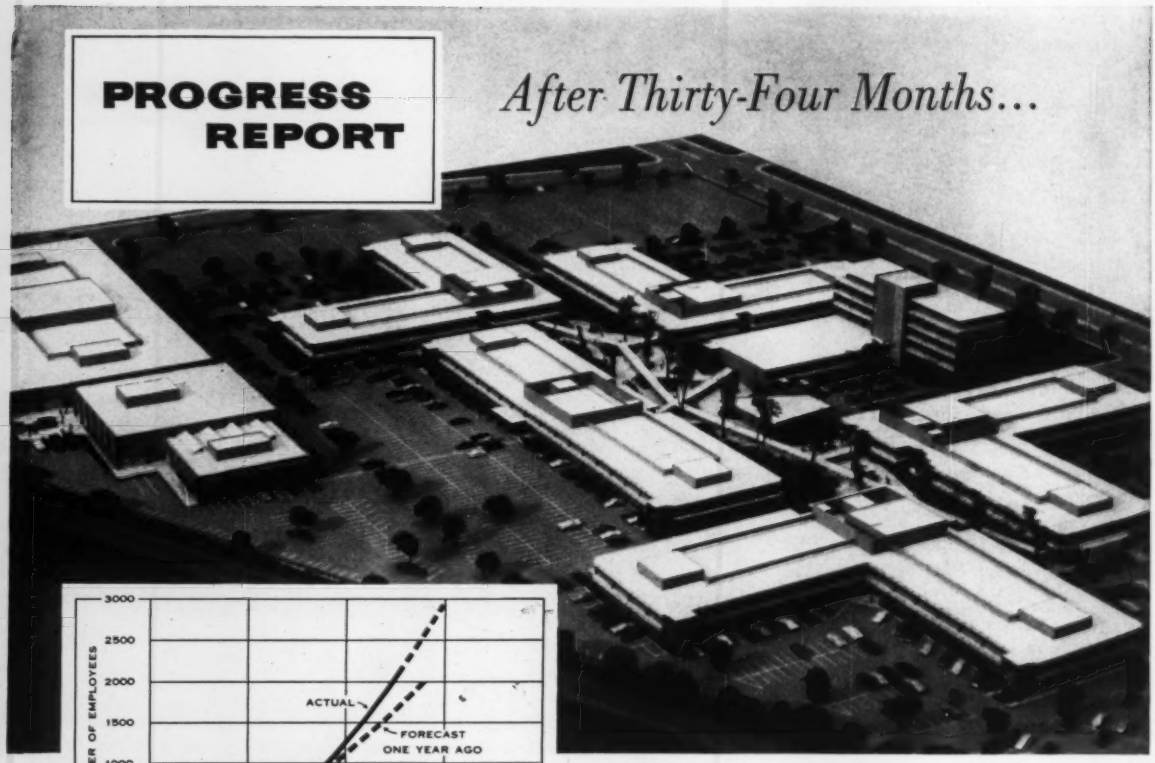
USS

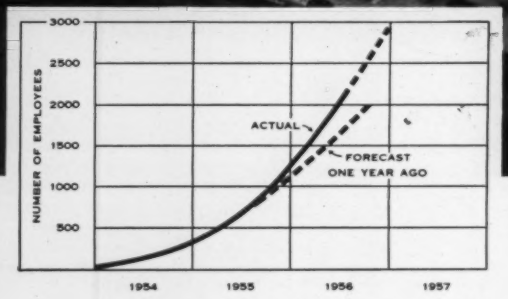
SEE The United States Steel Hour. It's a full-hour TV program presented every other week by United States Steel. Consult your local newspaper for time and station.

UNITED STATES STEEL

PROGRESS REPORT

After Thirty-Four Months...





RESEARCH AND DEVELOPMENT PERSONNEL The above curve shows the growth in Ramo-Wooidridge personnel which has taken place since our Progress Report one year ago. A significant aspect of this growth is the increase in our professional staff which today is made up of 135 Ph.D.'s, 200 M.S.'s and 265 B.S.'s or B.A.'s. Members of the staff average approximately ten years' experience.

FACILITIES Within the past few months, construction has been completed at our Arbor Vitae complex, which now consists of eight modern buildings of 350,000 square feet, four of which are illustrated at the bottom of the page. Nearby is the R-W flight test facility, including hangar, shop, and laboratories, located on a 7-acre plot at International Airport.

To provide additional space for our continuing growth, construction has been started on an entirely new 40-acre Research and Development Center, located three miles from the Arbor Vitae buildings. The photograph above is of a model of the Center, which we believe will be one of the finest research and development facilities in the country. The first three buildings, now under construction, will total 250,000 square feet.

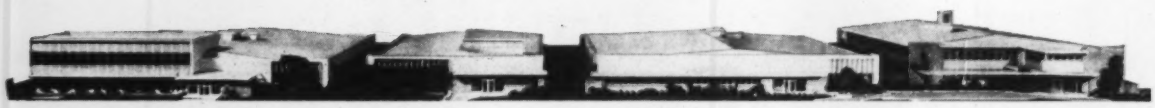
A second major construction program is underway on a manufacturing plant for quantity production of electronic systems. The initial unit of the plant, located on a 640-acre site in suburban Denver, Colorado, will be completed next spring and will contain approximately 150,000 square feet.

PROJECTS Our current military contracts support a broad range of advanced work in the fields of modern communications, digital computing and data-processing, fire control systems, instrumentation and test equipment. In the guided missile field, Ramo-Wooldridge has technical direction and systems engineering responsibility for the Air Force Intercontinental and Intermediate Range Ballistic Missiles. Our commercial contracts are in the fields of operations research, automation, and data processing. All this development work is strengthened by a supporting program of basic electronic and aeronautical research.

THE FUTURE *As we look back on our first three years of corporate history, we find much to be grateful for. A wide variety of technically challenging contracts have come to us from the military services and from business and industry. We have been fortunate in the men and women who have chosen to join us in the adventure of building a company. We are especially happy about the six hundred scientists and engineers who have associated themselves with R-W. Their talents constitute the really essential ingredient of our operations. We plan to keep firmly in mind the fact that the continued success of The Ramo-Wooldridge Corporation depends on our maintaining an organizational pattern, a professional environment, and methods of operating the company that are unusually well suited to the special needs of the professional scientist and engineer.*

The Ramo-Wooldridge Corporation

5730 ARBOR VITAE ST. • LOS ANGELES 45, CALIF.



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positions open • positions wanted • equipment, material, patents, books, instruments, etc. wanted and for sale • representatives • sales agencies • business for sale • partnership • capital • manufacturing facilities

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—of long-established technical magazine in the field of general mechanical engineering. Must be graduate mechanical engineer with some practical engineering and editorial experience. Under 30 years of age, with ability to do original writing, rewriting, and abstracting, reporting and interviewing, and willing to travel. Location New York. Permanent position. Apply by letter with photograph, record of school and engineering work, references, and salary expected.

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Engineers and designers with Steam Electric Generating Station, Refinery, or Process Plant experience will qualify. Mechanical engineers with related experience will be given thorough consideration.

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Mechanical engineers with instrument application experience on Steam Electric Generating Stations, Refinery or Process Plants. Related experience acceptable.

Liberal relocation allowances for you and your family.

Send resume to Manager of Employment & Placement Industrial Relations Division

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For an immediate personal interview you may phone:

Paul Keating, Murray Hill 7-7100, New York City
Joe Braddick, Fairfax 3-2401, Houston, Texas
Bill Milligan, Tucker 1549, Los Angeles, Calif.

NEW in the 1957 MECHANICAL CATALOG:

Mechanical Engineers Recruitment Guide

MECHANICAL ENGINEERS

Engineering graduates for product design and application. Products are vibration and shock isolation systems on aircraft, electronic, automotive, marine, general industrial equipment. This is a rapidly expanding industry. Excellent long range possibilities for engineers who are interested primarily in design work. Duties also involve extensive liaison between and among field engineering, manufacturing, and research.

BOX 369, ERIE, PENNSYLVANIA

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Major Oil Company has openings for Mechanical Engineers in several phases of refinery engineering. Locations near New Orleans and south Arkansas. Attractive salary and benefits program. In reply give age, education, experience and salary expected.

PAN AM Southern Corporation

P. O. Box 2
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MECHANICAL ENGINEER

To handle laboratory and technical service assignments on fuels. Opportunity in Major Oil Company for man with 3 to 5 years' direct or related experience with engine or burner fuels. Metropolitan New York.

Address CA-5870, % "Mechanical Engineering."

DESIGN ENGINEER CHALLENGE

for a Creative Type Man

who prefers the broad scope and individual opportunity of being in a small group of engineers designing and developing various types of Processing Equipment with emphasis on heat transfer type. A new and fast growing division of a long established New England firm, with installations that have already proven successful in many industries. Mail confidential resume of experience, salary requirements, etc., to:

Personnel Office
Rodney Hunt Machine Co.
Orange, Mass.

ENGINEER, DESIGN

Nuclear Aircraft Engines Mechanical Components and Systems

From all indications the jet age will be dwarfed by the age of the application of atomic power to aircraft. An opportunity to enter this unusual field in its early stages is now offered the qualified engineer by General Electric's Aircraft Nuclear Propulsion Department.

Assignments will involve the designs of mechanical components and systems for use with aircraft nuclear power plants. For this work an ME degree or equivalent is needed, plus 3 to 5 years' experience in design of mechanical devices, structures or systems analysis. Though not essential, work in aircraft power plant field is especially desirable.

Publication of research results in the appropriate classified or open literature is encouraged.

Openings in Cincinnati, Ohio and Idaho Falls, Idaho

Address replies in confidence stating salary requirements to location you prefer

J. R. Rosselot
P.O. Box 132
Cincinnati, Ohio

L. A. Munther
P.O. Box 535
Idaho Falls, Idaho

GENERAL ELECTRIC

DU PONT NOW OFFERS

SIX CAREER POSITIONS OF CHALLENGE AND RESPONSIBILITY IN SPECIALIZED AREAS OF MECHANICAL ENGINEERING

The Engineering Service Division of du Pont's Engineering Department provides consulting service and technical assistance to production, maintenance, design, research, and construction groups within the company. The Division's objectives are to assist other company units in improving plant efficiency and product quality, in reducing investment and operating costs, and in increasing capacity.

MATERIALS HANDLING

This position requires three to ten years' experience with bulk or package handling systems and equipment. The successful applicant will be expected to have engineering knowledge of belt conveyors, bucket elevators, screw conveyors, storage bins, chutes, hoppers, and feeders. Familiarity with pneumatic conveyors or mobile handling equipment is desirable. Duties include providing consultation on existing equipment, selection of new equipment, making cost studies, and development and execution of major materials handling engineering programs.

AIR CONDITIONING

Position requires substantial experience in selection and operation of heating, ventilating, air conditioning, and refrigeration equipment. Extensive knowledge of the following is desirable: Heating methods and systems, fans, building heat transmission, automatic controls, air cleaning devices, spray apparatus, sorbent materials, air duct design, exhaust and conveying systems, drying systems, health aspects of ventilation, piping and insulation, instruments and measurement, and investment and operating costs. Duties include consultation on evaluation and economic operation of such equipment.

POWER

Position requires extensive practical power experience including operation and maintenance of industrial steam power plant facilities and equipment testing. Some experience in steam plant design and construction or in thermal insulation of process piping and equipment is desirable. Duties include: making economic evaluations and involved heat balances for complicated power systems; assisting in specification of power equipment and in selection of new facilities; and determination of causes of equipment malfunctioning and development of recommendations for corrections.

PUMPS AND FLUID MECHANICS

Desired qualifications will include extensive engineering knowledge of and familiarity with equipment used in the fluid mechanics field. Development, research, design, maintenance, or teaching experience with pumps, compressors, jets, and seals is desirable. Responsibilities of the position will involve selection of equipment, trouble-shooting, and consultation on fluid flow and mechanical design aspects of piping, pumps, jets, compressors, and seals. Duties include evaluation of available equipment and recommendations for equipment modification for special applications.

MAINTENANCE ENGINEERING

Position requires five or more years' responsible experience on a supervisory or staff level in plant maintenance organizations, planning work, estimating manpower and material requirements, scheduling and controlling work, and accounting for the expenditure of maintenance funds. Successful applicant will consult on preventive and corrective maintenance problems such as: improved procedures and methods, training programs, machine tools and other maintenance equipment, plant maintenance organization, welding, and other related phases of plant maintenance.

EQUIPMENT IMPROVEMENT

Position requires 5 or more years' engineering experience in research, development, design, application, or maintenance of chemical process equipment and machines. Duties include: conducting mechanical engineering studies on chemical plant problems involving equipment design, mechanisms, machine components, and machine drives; and analyzing and solving problems in selection, operation, and maintenance of chemical process plant equipment. Qualifications should include sound practical knowledge of engineering economics, machine design, fluid mechanics, or applied mechanics.

FOR PERSONAL INTERVIEWS

and an appointment with our technical representative in the following cities, please call:

DENVER	LOS ANGELES	NEW YORK	DALLAS
Sun-Mon-Tues-Wed	Sun-Mon-Tues-Wed-Thurs	Sun-Mon-Tues-Wed	Sun-Mon-Tues-Wed
Sept. 9-10-11-12	Sept. 16-17-18-19-20	Sept. 16-17-18-19	Sept. 23-24-25-26
Mr. J. C. Costello, Jr.	Mr. J. C. Costello, Jr.	Mr. H. C. Hoyt	Mr. J. C. Costello, Jr.
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For the answer, turn to page 183

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offer outstanding jobs with interesting futures for Mechanical Engineers

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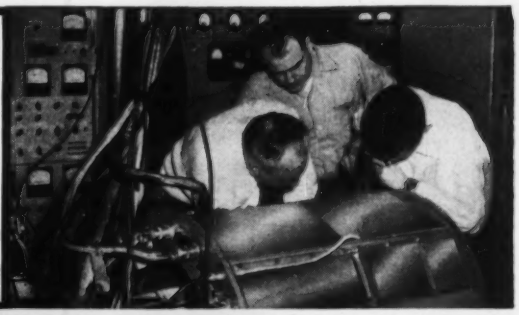
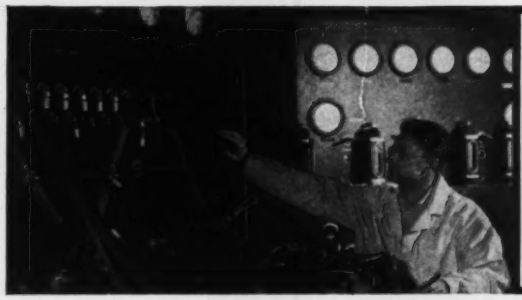
Mechanical engineers are needed to design and conduct test work in electronic packaging for a top-flight missile project. Experience in package design, cabling, component integration, coupled with the solution of environmental problems involving vibration, temperature and shock, is required.





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Engineers are needed to participate in the development and testing of advanced ram-jet engines and systems. Experience in any of the allied fields of fluid mechanics, heat transfer, combustion research, fuels, engine testing, hydraulic systems, turbines, pumps and engine instrumentation is desirable.

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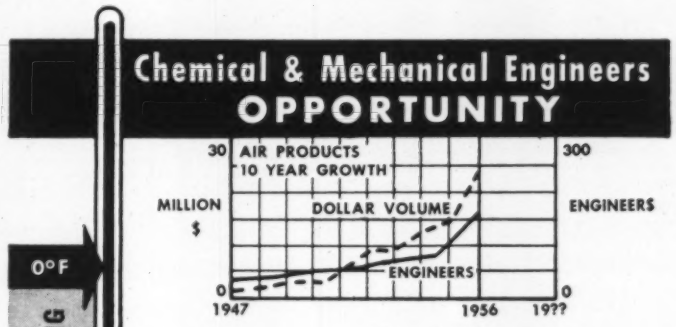

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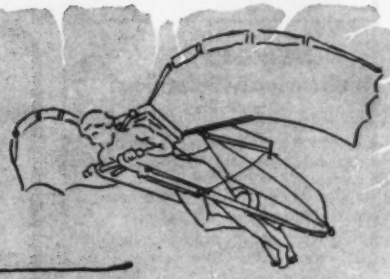
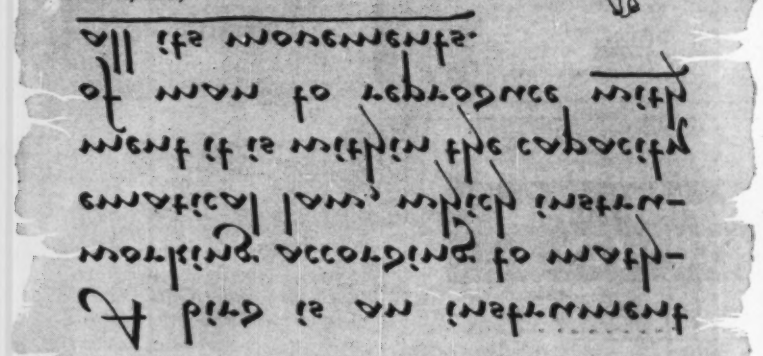
Leonardo Da Vinci's experiments in flight and his insight which approached prophecy, are revealed in manuscript notes, written by him in reversed mirror-image writing. (To read inscription place mirror upright above top line.)





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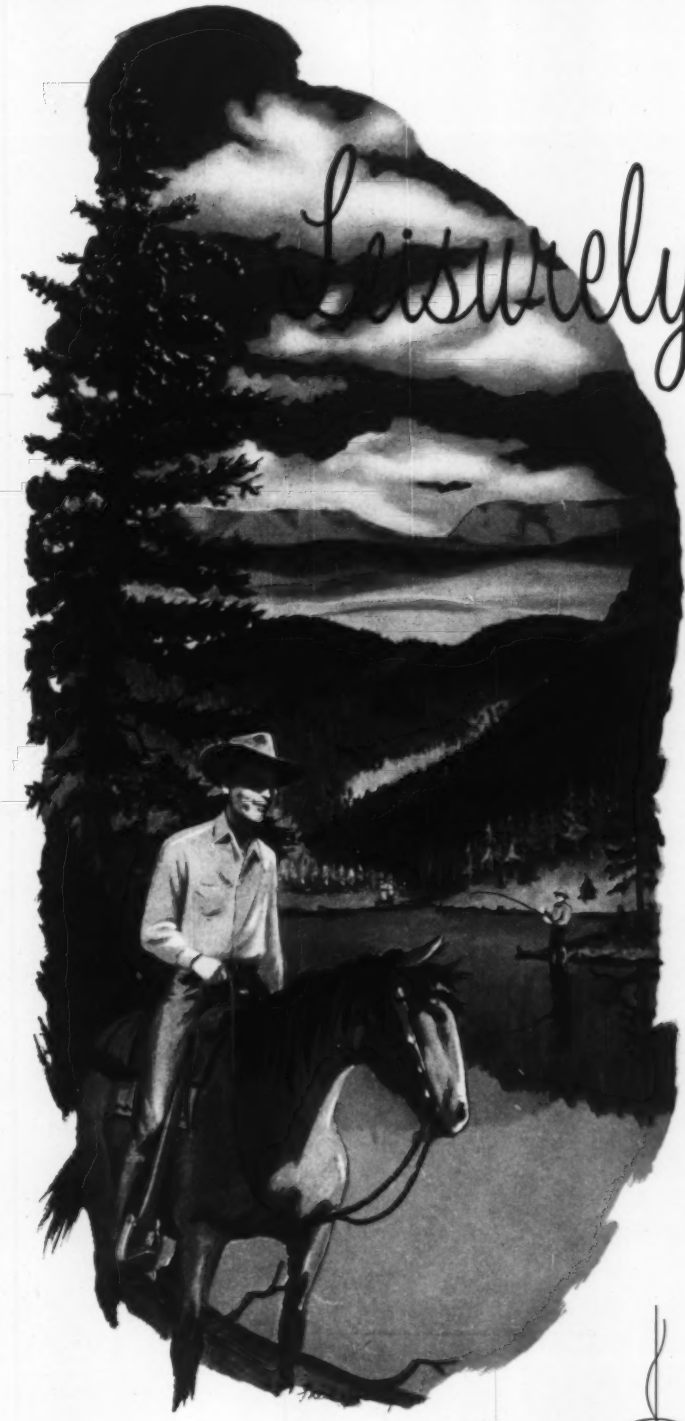

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Director of Scientific Personnel
Division 1207

los alamos
scientific laboratory
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Mechanical, electrical, chemical, structural, and architectural engineers, designers, and draftsmen needed for design of oil and petrochemical facilities.

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Engineers with knowledge of pneumatic, hydraulic and electrical automatic instruments, and experience in their application to continuous processes.

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BOX CA-5875

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and geographic preference to:
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At RCA your M.E. degree can bring you up to $10,000 plus future advancement

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RCA **RADIO CORPORATION OF AMERICA**

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. . . if YOU are interested in MORE than "just a job"

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Engineering Department

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MECHANICAL ENGINEERS

INSTRUMENT ENGINEERS

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MECHANICAL ENGINEERS
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Unusual and challenging career openings are offered in liquid nitrogen APPLICATION DEVELOPMENT

- **indefinite preservation and processing of biological materials.**
- **design of liquid nitrogen vacuum insulated containers.**
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Bachelors or Masters are invited to investigate

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a division of
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Personnel Department, Harrison Division
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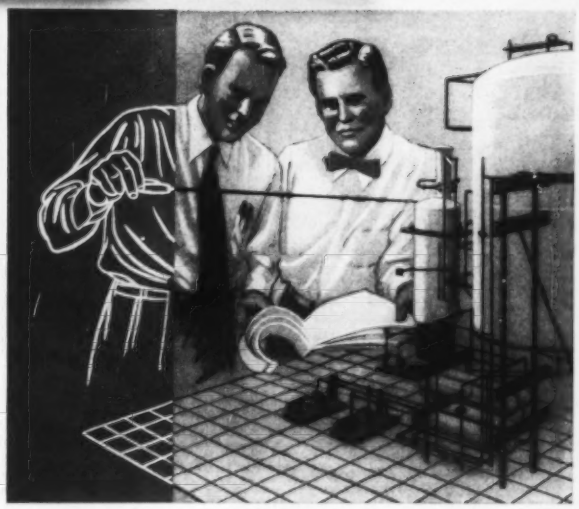

Engineers—

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engineer

ME AE EE

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ENGINEERS—PHYSICISTS

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- **B.S. or M.S. degree and experience in process equipment construction, design, inspection, or maintenance, petroleum product testing and field evaluation, or related work background.**
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CLYDE A. BRUGGERS
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THE STANDARD OIL COMPANY (OHIO)

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it takes more than ability for an engineer to achieve promotion

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ITE

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Address CA-5819, % "Mechanical Engineering."

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Career opportunities for mechanical and electrical engineers in the development of new electrical welding or gas-application processes and equipment for metal producers and fabricators.

Ideal for the young engineer with a family—near pleasant suburban residential areas with excellent schools—also near urban centers. Congenial work surroundings along with completely modern experimental facilities—liberal Corporation benefits. Please include resume when communicating with Dept. ME.

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A Division of
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Immediate openings for men with 2 to 5 years' experience in development, selection and application of mechanical equipment for petroleum and petrochemical plants. Duties will include considerable vendor and customer contacts and field trouble shooting.

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Please send resumes, including salary requirements, to R. L. Stacom. All inquiries in confidence.

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711 Third Ave. New York 17, N. Y.

MECHANICAL ENGINEERS

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The expanding acetylene program at our new, air conditioned Speedway Laboratories located in suburban Indianapolis offers unusual and challenging career openings involving:

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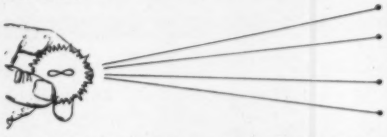
- fluid flow
- catalysis
- gas kinetics
- thermodynamics
- pressure vessel design

Engineers interested in the above fields and capable of assuming responsibility for new projects are needed for:



DEVELOPMENT of novel methods of acetylene production and distribution

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ENGINEERING for our production and distribution systems

TECHNICAL SERVICE for Linde's nationwide acetylene business.

B.S., M.S., or Ph.D. graduates submit resume covering education (include approximate academic achievement), experience and work interests to:

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a division of
UNION CARBIDE AND CARBON CORPORATION
P. O. Box 8237, Indianapolis 24, Indiana
Attention: Mr. J. J. Restosky
Refer to ad: ME-A

ENGINEERS

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BOAT
STEPS-UP
NUCLEAR
SUBMARINE
PROGRAM

offers unusual growth opportunities to engineers

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Now, engineers who are cognizant of the implications of the Atomic Age are concentrating their interest on Electric Boat. The following opportunities exist for:

a) **Naval Architects**

b) **Mechanical and Electrical Engineers** with 3 to 5 years experience in the application of mechanical and electrical marine power plant equipment.

c) **Electrical and/or Mechanical Engineers** for basic design using analog computers, with respect to control systems, motor control circuits, power plant, speed and voltage regulators or fluid flow and thermodynamics. Familiarity with engine room and reactor plant electrical systems and controls desirable.

At Electric Boat your professional success is spurred by company sponsored courses at the plant, advanced study at leading universities, and by attention to broader professional growth by immediate supervision.

Electric Boat's location in Groton on the lovely shore of Long Island Sound makes life as pleasant as your job is stimulating. The surrounding resort area is well known for its year-round sports and recreational activities. And, you have all the advantages of nearby New York and Boston as well.

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ELECTRIC BOAT
Division of General Dynamics Corporation
GROTON • CONNECTICUT

ENGINEER, AE, ME

aircraft structural design for

NUCLEAR POWER PLANTS

It is a truism that history is only made by history-makers. No one will dispute the truth of this when it comes to General Electric's pioneering work in applying nuclear energy to aircraft propulsion. Many specialized and highly qualified talents are engaged in this vital area. More are needed.

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P. O. Box 132
Cincinnati, Ohio

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Idaho Falls, Idaho

GENERAL ELECTRIC

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ENGINEERS . . . . .

When an established Company of the stature and stability of the Linde Air Products Company embarks on a planned program of PRODUCT DIVERSIFICATION, it provides a. . . .

UNIQUE OPPORTUNITY

. . . . for Mechanical and Chemical Engineers with creative talent and business judgment.

If interested in this really unusual opportunity, submit complete resume including education (approximate academic standing) and experience to:

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a division of
UNION CARBIDE AND CARBON CORPORATION
P. O. Box 8237, Indianapolis 24, Indiana
Attention: Mr. J. J. Rostosky
Refer to ad: ME-PD

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Take Advantage of Unusual Opportunities With . . . . in FLAME PLATING

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- process engineering
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- acoustic engineering
- corrosion
- wear
- surface finishing

B.S., M.S., or Ph.D. graduates with up to 5 years' experience and demonstrated technical ability are needed for:

- DEVELOPMENT
- RESEARCH
- PRODUCTION
- SALES

Send complete resume including education (approximate academic achievement), experience and work interest to:

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a division of
UNION CARBIDE AND CARBON CORPORATION
P. O. Box 8237, Indianapolis 24, Indiana
Attention: Mr. J. J. Rostosky
Refer to ad: ME-FP

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Electrical and mechanical, interested in work involving design of equipment of a specialized nature, instrumentation research, and development of specialized test procedures. Should be capable of generating ideas and following them through the design and experimental stages. Position offers diversity of activities and excellent opportunities for creative work. Please send complete resume of education and experience to

Southern Research Institute
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Two recently graduated Engineers, one Mechanical and one Electrical, with B.S. Degree, to train for future responsible positions on Class 1 railroad located in western Pennsylvania. Practical railroad experience desired but not necessary.

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Recent Graduate
Maximum Age 35

General Office. Assistant to Production Engineer—Special Studies in Steam and Hydro Production Engineering For Public Utility in So. Calif.

Address CA-5861, % "Mechanical Engineering."

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Mechanical Draftsman experienced in power plant piping. Wonderful opportunity. Comprehensive fringe benefits. Write stating education, experience and salary desired. Duke Power Company; Employment Office; P.O. Box 2178, Charlotte, N. C.

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Mechanical Engineer

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This is an especially good opportunity for you to gain the exceptional professional and personal advantages enjoyed by engineers at General Electric's Jet & Rocket Engine Center.

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You will be responsible for carrying out programs for: preparing, issuing, and maintaining advanced engine Model and Test Specifications; continuously reviewing engineering changes and test results as they affect specifications and initiating corrective action; and preparing reports—all to assure engineering compliance with specifications requirements.

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Technical Personnel, Bldg. 100
AIRCRAFT GAS TURBINE DIVISION

GENERAL ELECTRIC
Cincinnati 15, Ohio

Mechanical Engineers

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You will direct the design and development of accessory drive gear boxes for advanced aircraft engines. Your responsibilities will range from detail designing to planning and completion of development programs, including scheduling, budgeting and technical direction, of other Unit Engineers. Professional advancement comes fast—in Flight Propulsion—at this major company.

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BOX CA-5892, CARE OF "MECHANICAL ENGINEERING."

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Replies held confidential. Please send complete resume, including salary expected and details of education and experience.

Address CA-5865, % "Mechanical Engineering."

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CYANAMID

New CRESLAN Acrylic Fiber

Mechanical engineers experienced in the design of synthetic textile fiber machinery are needed for Cyanamid's newest expansion program.

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ENGINEER, ME or CE

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Liberal benefits and retirement program. Community of 50,000 in Wisconsin vacation-land on the Mississippi. Write listing education, experience, salary required to:

Manager of Staff Employment

THE TRANE COMPANY
LA CROSSE, WISCONSIN

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Mechanical Engineer, M.S. or Ph.D., with sound academic training in applied mechanics, mathematics, and materials, for research in vibration and other related problems. Experience in this area desirable, but not necessary if academic background satisfactory.

Laboratory located in suburban Spokane, Washington. Pleasant climate and living conditions year around.

Please send transcript of undergraduate and graduate credits, personal and business resume to:

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Dept. of Metallurgical Research
Spokane 69, Washington

Attention: Dr. Fred W. DeMoney, Head Mechanical Metallurgy & Evaluation Branch

All applications will be acknowledged and held in strict confidence.

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Engineers in training... Experienced engineers...

... there's no limit to the opportunities open to you as members of the OMAR team in the fields of:

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aeronautical engineers
stress analysts
turbine engineers
thermodynamicists
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Denville 4, New Jersey

Marquardt Aircraft Company
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3907

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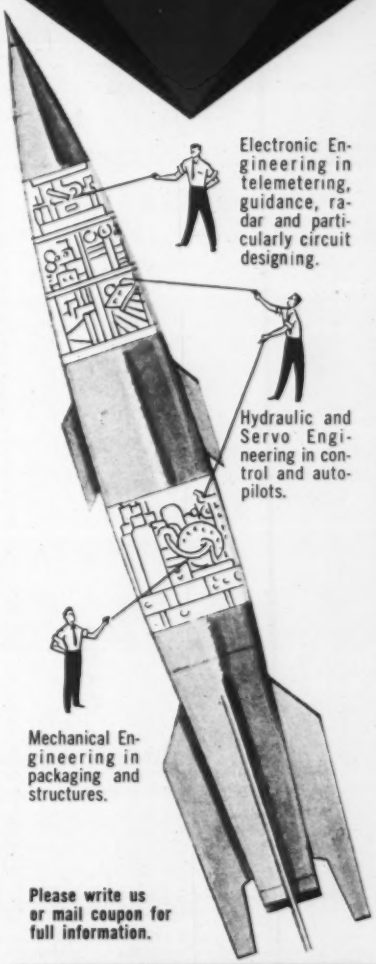

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Please write us or mail coupon for full information.

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11604 Sherman Way, North Hollywood, Calif.

I am interested in this engineering field____
I am a graduate engineer with____degree.
I am not a graduate engineer but have____years experience.

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Address _____

City _____

Zone____State _____

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- INSTRUMENTATION AND CONTROLS
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- PILOT PLANT DESIGN AND OPERATION
- PROCESS ENGINEERING
- STRESS ANALYSIS

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LOCATION: Our Tonawanda Laborstories in suburban Buffalo, New York—LINDE'S largest research and development facilities.

B.S., M.S., Ph.D. graduates—send resume covering education (approximate academic achievement), experience and work interests to:

LINDE AIR PRODUCTS COMPANY
a division of
UNION CARBIDE AND CARBON CORPORATION
P. O. Box 44, Tonawanda, New York
Attention: Mr. P. I. Emch
Refer to ad: ME-L

MECHANICAL ENGINEERS

Several excellent opportunities available with major producer of synthetic fibers and films. Openings are current in plant engineering departments in Pennsylvania, Virginia, and West Virginia.

Graduate mechanical engineers with 0-5 years of experience in machine and equipment design, mechanical layout, engineering maintenance, or related activities are invited to reply.

Please send resume including details of education, experience, and salary requirements to:

Personnel Recruitment Department
AMERICAN VISCOSE CORPORATION
1617 Pennsylvania Boulevard
Philadelphia 3, Pennsylvania

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MAN WITH EXPERIENCE in all phases of plant engineering, including plant layout. Experience in the direction of others desirable. Position open in well established large eastern seaboard machinery manufacturer. Address CA-5885, care of "Mechanical Engineering."

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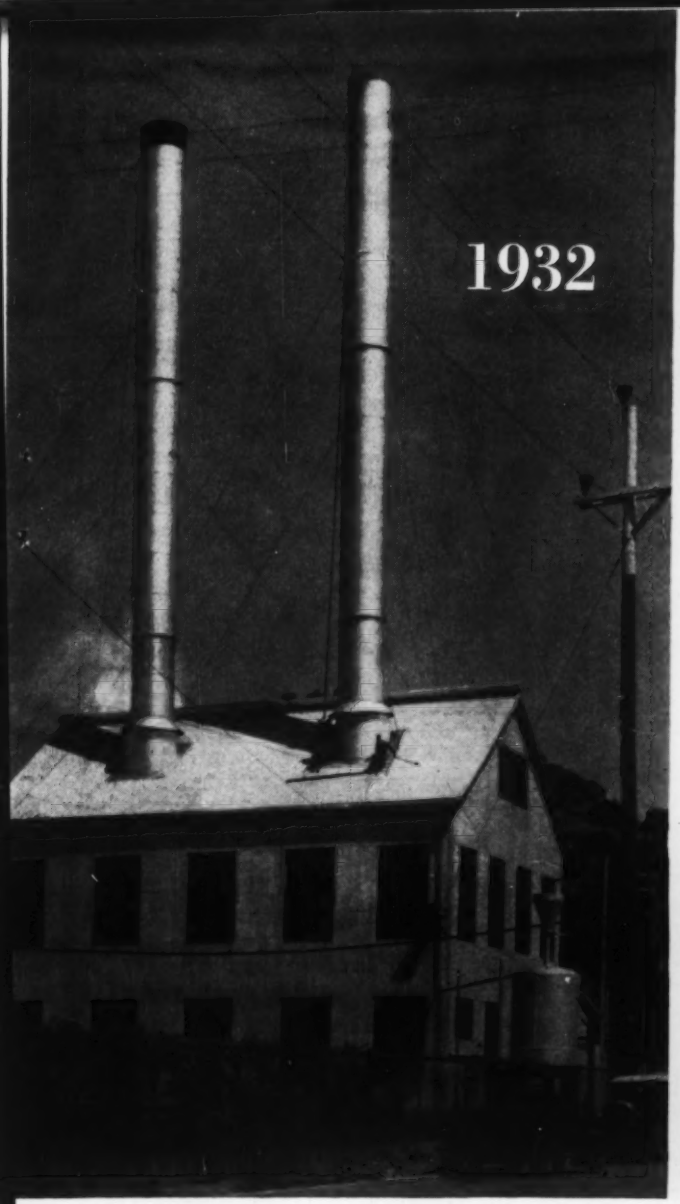

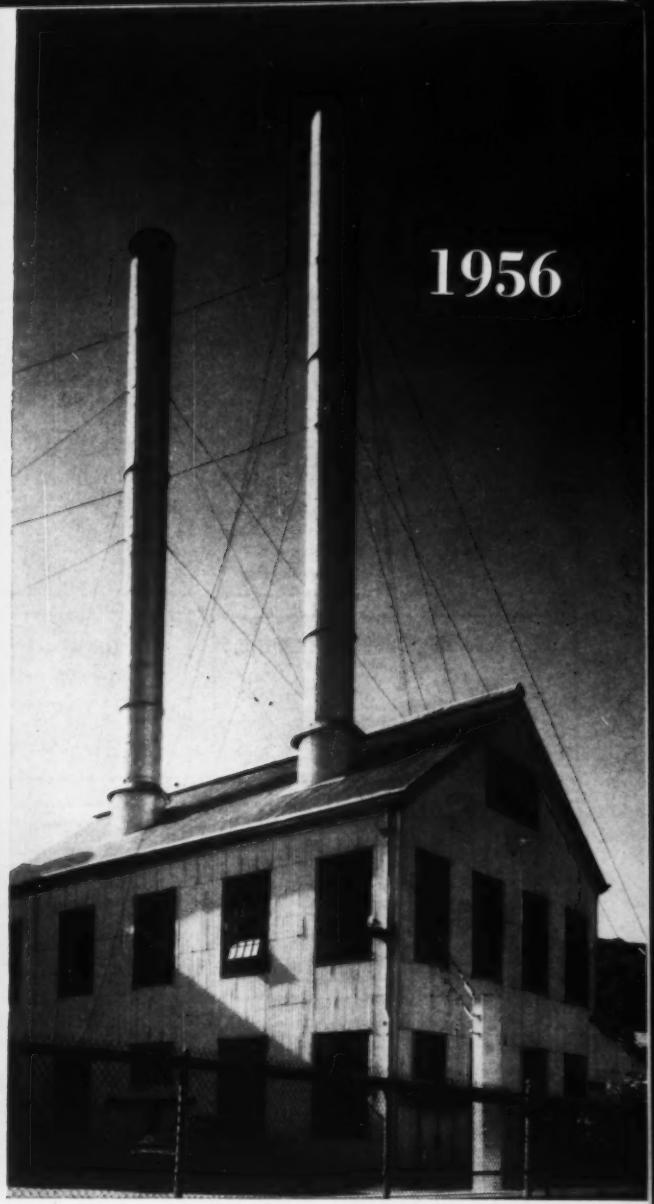

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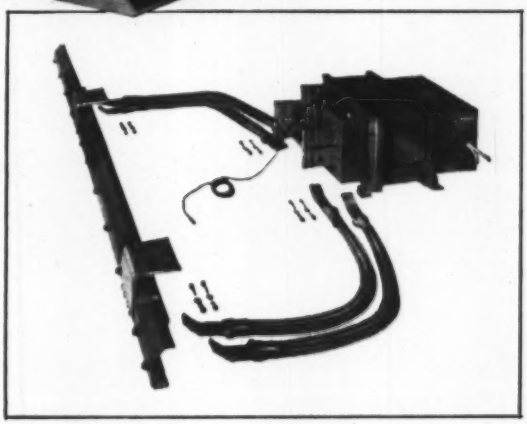

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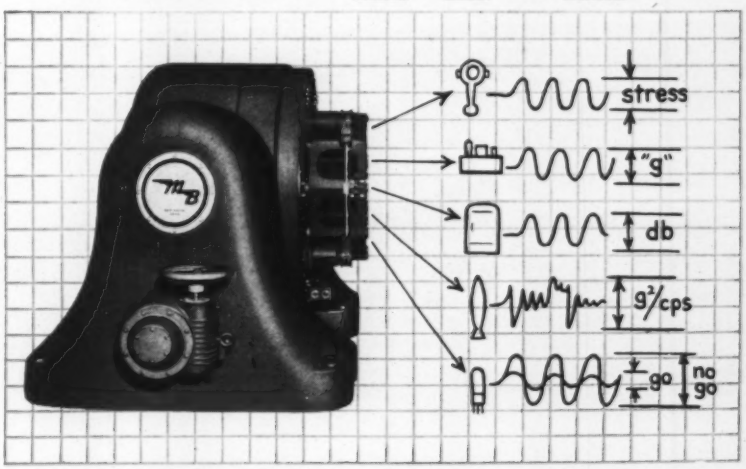

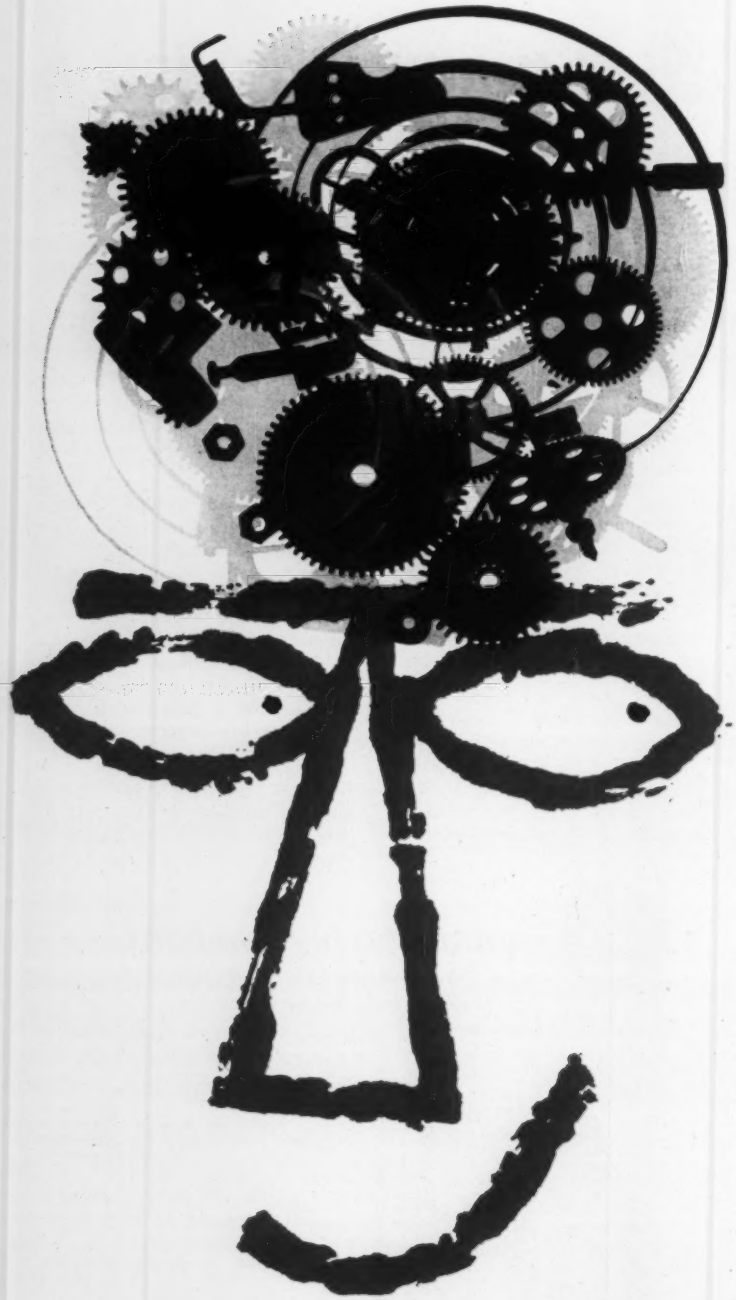

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. . . World's most versatile GLOBE VALVE

Wherever bronze globe valves are used, there's an LQ600 that's best for the job . . . any size from ¼ to 2 inches, any pressure up to 200 lbs. steam or 400 lbs. water, oil, gas, and air.

LQ600 is best for the job, because its performance has not been matched by any other valve.

The Brinalloy* seats and discs are fused in to stay and have never been known to leak or fail in over 5 years of tests and in more than 100,000 installations.

Brinalloy* seats and discs resist wear and corrosion far better than 500 Brinell Stainless Steel and outwear even case hardened Stainless Steel exceeding 1000 Brinell.

You'll be money ahead for years to come when you standardize on *the world's most versatile bronze globe valve.* Keep LQ600-150 and LQ600-200 in stock to replace your conventional bronze valves as they fail. Now's the time to stop those expensive leaks . . . in both your piping and profits.

*Patented alloy T. M. Reg.

FIG. LQ 600-150
150 lb. S.P. 300 lb. W.O.G.

FIG. LQ 600-200
200 lb. S.P. 400 lb. W.O.G.
¼ to 2 Inches

See your Lunkenheimer Distributor for literature, or write The Lunkenheimer Company, Box 360, Cincinnati 14, Ohio.

BRONZE • IRON • STEEL • PVC

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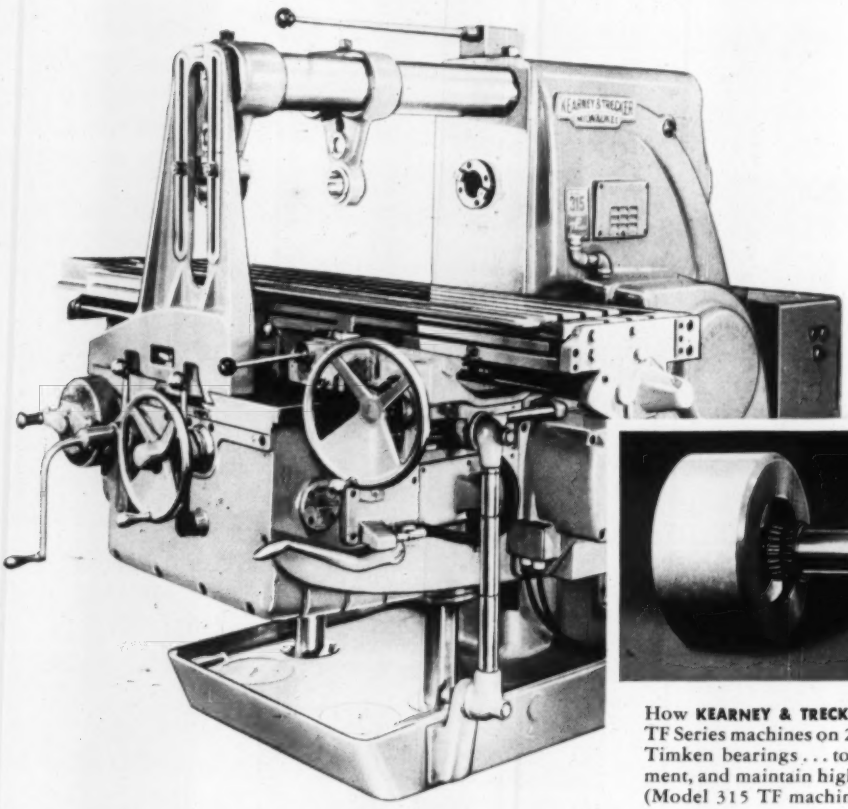
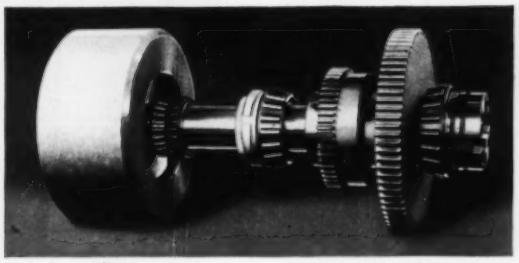




How **KEARNEY & TRECKER** mounts the spindle of its TF Series machines on 2 single-row and 1 double-row Timken bearings . . . to hold spindle in rigid alignment, and maintain high accuracy through 24 speeds. (Model 315 TF machine illustrated).

New milling machine gets constant accuracy through 24 speeds with spindle on TIMKEN® bearings

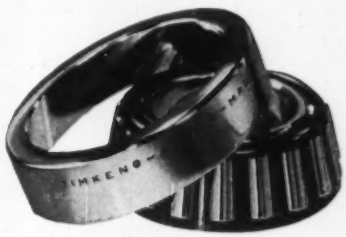
FROM 15 to 1500 rpm, with 24 speed changes in all, and plenty of capacity for any tool load—that's the new TF Series of twin-screw designed Kearney & Trecker mills. There are 28 Timken® bearings contributing to these machines' built-in stamina and constant high precision. Most importantly, the spindle is mounted on two single-row and one double-row Timken precision bearings which hold it in rigid alignment through all speed and load changes. Chatter is eliminated, and long bearing life with minimum maintenance is assured.

Because of their tapered design, Timken bearings take radial and thrust loads in any combination. Full line contact between rollers and races imparts extra load-carrying capacity. And of course, with Timken bearings designed to last as long as the machine itself, maintenance costs go down.

Geometrically designed to give true rolling motion, Timken bearings are precision manufactured to live up to their design—produced under rigid inspection and quality control. We even make our own fine alloy steel, something done by no other American bearing manufacturer. When you build or buy equipment, look for the "TIMKEN" trade-mark on every bearing. The Timken Roller Bearing Company, Canton 6, Ohio. Canadian plant: St. Thomas, Ontario. Cable address: "TIMROSCO".

TIMKEN BEARING EQUIPPED

This symbol on a product means its bearings are the best.



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TAPERED ROLLER BEARINGS ROLL THE LOAD